Ontario. Hydro-Electric Power Commission

THE BULLETIN

VOL. XI. NO. 12.

Hydro News

Hydro-Electric Power Commission of Ontario

JANUARY - DECEMBER 1924 - 1925

Vol. 11 - 12

HYDRO MUNICIPALITIES

CENTRAL ONTARIO SYSTEM

	Pop.
Belleville	12,243
Bloomfield	550
Bowmanville	3,447
Brighton	1,375
Camden East Twp.	2,982
Cobourg	5,459
Colborne	829
Darlington Twp.	3,407
Deloro	298
Deseronto	1,928
Havelock	1,266
Kingston	22,368
Lakefield	1,146
Lindsay	7,840
Madoc	1,078
Marmora	853
Millbrook	733
Napanee	2,992
Newcastle	619
Newburgh	434
Norwood	711
Omemee	557
Orono	700
Oshawa	12,246
Peterboro	21,790
Pickering Twp.	4,382
Picton	3,189
Port Hope	4,567
Richmond Twp.	1,944
Seymour Twp.	2,506
Stirling	778
Trenton	5,881
Tweed	1,268
Wellington	850
Whitby	4,131
Whitby Twp.	1,785
Whitby E. Twp.	3,747
Total	142,879

ESSEX COUNTY SYSTEM

Amherstburg	2,820
Canard River	50
Cottam	333
Essex	1,753
Harrow	619
Kingsville	2,010
Leamington	3,864
Total	11,449

EUGENIA SYSTEM

Alton	450
Artemesia Twp.	2,316
Arthur	1,218
Brant Twp.	
Chatsworth	326
Chesley	1,803
Derby Twp.	1,507
Dundalk	690
Durham	1,622
Elmwood	350
Flesherton	417
Grand Valley	595
Hanover	2,842
Holstein	285
Horning's Mills	350
Kilsyth	
Kincardine	2,156
Kinloss Twp.	
Lucknow	918
Markdale	927
Meaford	2,406
Mount Forest	1,825
Neustadt	444
Orangeville	2,503
Owen Sound	12,360
Paisley	749
Priceville	
Ripley	670
Shelburne	1,075
Tara	597
Teeswater	807
Wingham	2,470
Total	44,678

MUSKOKA SYSTEM

Gravenhurst	1,621
Huntsville	2,316
Total	3,937

NIAGARA SYSTEM

	Pop.
Acton	1,742
Agincourt	
Ailsa Craig	535
Alvinston	659
Ancaster	400
Ancaster Twp.	4,124
Aylmer	2,241
Ayr	796
Baden	710
Barton Twp.	6,742
Beachville	503
Belle River	580
Bertie Twp.	
Beverly Twp.	
Biddulph Twp.	1,640
Blandford Twp.	
Blenheim Twp.	
Blenheim	1,528
Blyth	692
Bolton	656
Bothwell	630
Brampton	4,406
Brantford	32,786
Brantford Twp.	7,301
Breslau	500
Brigden	400
Brussells	872
Burford	700
Burford Twp.	3,886
Burgessville	300
Caledonia	1,308
Caradoc Twp.	
Chatham	15,525
Chingnacousy Twp.	
Chippawa	1,099
Clifford	
Clinton Twp.	
Clinton	1,941
Comber	800
Copetown	230
Courtright	425
Crowland Twp.	
Dashwood	350
Delaware Twp.	
Delaware	350
Dereham Twp.	3,200
Dorchester	400
Dorchester S. Twp.	1,436
Dorchester N. Twp.	
Dover E. Twp.	
Drayton	602
Dresden	1,393
Drumbo	375
Dublin	218
Dumfries N. Twp.	
Dumfries S. Twp.	
Dundas	5,054
Dunnville	3,569
Dutton	870
Easthope N. Twp.	
Easthope S. Twp.	
Ekfrid Twp.	
Elmira	2,400
Elora	1,199
Embro	463
Etobicoke Twp.	10,463
Exeter	1,458
Fergus	1,815
Flamboro W. Twp.	
Flamboro E. Twp.	2,624
Ford City	5,113
Forest	1,386
Georgetown	2,554
Glencoe	779
Goderich	4,287
Grantham Twp.	3,456
Granton	300
Guelph	17,922
Galt	13,332
Hagersville	1,271
Hamilton	120,235
Harriston	1,326
Harwich Twp.	
Hay Twp.	
Hensall	687
Hespeler	3,059
Highgate	403
Howard Twp.	
Humberstone Twp.	
Ingersoll	5,422
Jarvis	480
Kitchener	23,027
Lambeth	350
Listowel	2,571
Lobo Twp.	
London	61,639
London Twp.	6,073
Louth Twp.	2,312
Lucan	614
Lynden	622
Markham	941
Markham Twp.	
Merlin	
Merritton	2,589
Milton	1,900
Milverton	1,029
Mimico	4,187

THE
BULLETIN

Published by
HYDRO-ELECTRIC POWER COMMISSION
of Ontario

190 University Avenue
Toronto

Subscription Price $2.00
Per Year

CONTENTS

Vol. XI. No. 1.

JANUARY, 1924

Electrical Accidents in Homes

A report comes from London, Ont., of a fatality to a woman while attempting to move an electric heater while in her bath. Accidents of this kind are always to be regretted, yet we should not discontinue our efforts to prevent them. By its system of inspections and approvals the Commission is endeavoring to do everything in its power to make electricity safe, thereby protecting property and the lives of the unsuspecting. There are, however, conditions that may prove dangerous, and it is in regard to these that the public should be continually warned. The following editorial from The Globe cannot be too widely circulated, the instructions given therein should be firmly impressed upon the mind of every man, woman and child whose homes are served with electricity:

"Electricity is a servant which must be handled with care to avoid a fatality such as that in a London home. The victim reached out from a bathtub to move a nearby electric heater and received a shock from which she died in a few minutes. The Coroner's inquest will show whether there was any defective insulation about the heater. In either case, so many similar accidents have happened to persons in bathtubs that all should remember while there not to touch electrical appliances of any kind. Water aids in conducting the current to the

body, and it is almost equally dangerous, for example, to touch an electric light switch with one hand if the other is in a basin. Under such circumstances the voltage need not be heavy to be deadly. On board ship persons have received a fatal shock from a current of only 30 volts. Regulations have been drafted for the proper wiring and insulation of all kinds of installations, but even if these regulations have been carefully followed out all users of electricity should refrain from touching electric lights or appliances while in their bathtub."

Hydro Power Crisis In Ontario

By SIR ADAM BECK

Chairman, Hydro-Electric Power Commission of Ontario

THE Province of Ontario must for generations to come carry its share of the enormous burden of taxation arising out of the cost of the World War. As the world at large gradually reverts to the normal, as it must do, useful production will tend more and more to liquidate the debts of the war, but, this process will be long drawn out, and under present conditions will only lessen the burden on the individual by almost inappreciable stages over a long period of years. Obviously the only effective way to hasten this process and to materially lessen the tax burden on the individual, apart from making him work harder, is to distribute that burden over a greater number of individuals. In a comparatively new country this simply means the development of natural and basic resources in such a way and in such a sequence as to provide sustenance for a maximum number of people. In other words, Ontario's most effective means of reducing the individual tax burden is to increase her population by increasing production, and by so doing reduce the share of taxation to be carried by each citizen. There is nothing new in this idea, which is only common-sense economics, and it is mentioned only for the purpose of applying it to the power situation as it stands to-day.

An Aid to Production.

In Ontario, as elsewhere, agriculture was the original population producer, but it has now, in western Ontario particularly, reached such a stage of development that any larger future increase in population through its agency cannot be expected. The compensating fact is that within the last decade the greatest economic influence in Ontario has been hydro-electric power, and more particularly Niagara power. Niagara power will maintain its status as a population increaser until the resources of Niagara are exhausted. When that time has come it will thereafter exercise the more limited function of a population sustainer, and west-

ern Ontario will have reached the limit of her industrial development and the maximum of her capacity for supporting population from this source. This conclusion brings with it the startling realization that such a condition will obtain, as regards Niagara, not later than the year 1940, not only with respect to the present treaty limit, but to the actual possible physical limit of diversion.

Facing a Power Crisis.

Moreover, statistics prepared by the commission's engineers show that all the power now available at Niagara, including the maximum possible capacity of the great plant at Queenston, will be exhausted by the year 1926, and that all the available additional power which can be commercially developed in the Trent district will be in use on the central Ontario system by the same date.

We are, therefore, actually face to face with a power crisis, and within the next two or three years drastic, if not desperate, measures must be taken in order to protect the Province against a serious stoppage in industrial activity.

The solution of this grave problem involves three possible alternatives, all of which demand immediate constructive measures; namely, the duplication of the Queenston-Chippawa development, or the development of power on the St. Lawrence River at Morrisburg, or the building of large auxiliary steam plants.

Should Develop St. Lawrence.

The immediate realization of the alternative is largely discounted by the inevitable delay which will arise out of the necessary international negotiations for the enlargement of the Boundary Waters Treaty. Furthermore, the physical conditions at Niagara demand a large initial capital outlay for a waterway which must of necessity be built for the full ultimate capacity of the installation, no matter how small the initial demand for power may be.

The second alternative would furnish the ideal solution for two main reasons; first, because the capital outlay and time necessary to construct would be only half of that required at Niagara, and second, because, while eastern Ontario would be primarily benefited, effective assistance could also be given to the Central Ontario and Niagara Systems through a high-voltage tie-line between Cornwall and Toronto.

The construction of auxiliary steam plants is the only alternative which appears to furnish an immediate and sure method of meeting the impending power crisis at the present time. Within the next 20 or 25 years the Province will probably be driven to the use of steam or some other form of fuel-generated power unless modern science devises some entirely new means of harnessing the potential energy of natural forces, but it will be unfortunate indeed if immediate recourse is necessary to steam power with the immense power resources of the St. Lawrence ready to hand as the ideal remedy for the present crisis.

Need to Conserve Resources.

Reverting again to the general economic situation, the approaching exhaustion of the water-power resources of the Province reveals the urgent necessity of so developing and using this strictly limited quantity of surplus power as to defer the date of ultimate exhaustion as far as possible, and at the same time assure a maximum of economic benefit to the territory served. From the standpoint of population increase and the effective reduction of the individual tax burden, it seems obvious that an industry which will sustain ten average families through the use of 50 horsepower is to be preferred to an industry which uses 5,000 horsepower to sustain a like number of families. This comparison roughly differentiates between a fabricating industry, such as a woollen mill, and a basic industry, such as an electric steel plant. It is also quite obvious that the solution of this complex economic problem does not lie in any such foolish policy as the suppression of basic industries, but rather in actually providing a wider field for their development, thereby instituting a smooth-working economic reaction which will allow greater scope for the establishment of a maximum of population-producing industries through the further development of what still remains of our direct and continuous sources of hydraulic energy supply.

So far as eastern, central and southwestern Ontario are concerned the only logical and feasible means of effecting this economic reaction is the development of the international water powers on the St. Lawrence River and the Ottawa.

Stimulation of Industry.

Extending back from the north shore of the St. Lawrence in Ontario, lies a territory rich in minerals and arable land, with ideal manufacturing sites, fine harbor facilities and unrivalled shipping possibilities. This picture is transformed by the vision of great international power projects on the St. Lawrence ultimately producing 2,000,000 horsepower of saleable power, equally divided between the two countries; by the vision of the Ontario shore studded with the great basic industries which will ultimately provide the base load necessary to make these developments commercially feasible; by the possibility of concentrates from the northern mines and pulpwood from the northern forests being here reduced and fabricated into a multitude of finished products; by the certainty of these products being delivered to the markets of the world in ocean-going ships or over nationally owned and electrified railways; and, over all, the protection of an Imperial preferential tariff.

Beyond this one can imagine the contiguous agricultural lands expanding and becoming rich through demands of the populous communities to which these basic industries, and their subsequent dependent industries, will give birth,

and the final vision of a 250,000-volt trunk transmission line connecting the cities of Cornwall and Toronto, forming a link between the St. Lawrence and Niagara which will afford mutual protection to both systems against interruption of supply to important public utilities, and which will make available for temporary use any surplus power which either system can spare or utilize, as the case may be. In fact, not only will the two great Niagara and St. Lawrence Systems be linked together with the Central Ontario System as the middle link, but the Northern Rideau and Ottawa Systems may also in time be made available for reciprocal interchange of capacity through connection to this main trunk line, and all will participate in the beneficial results of combination and interconnection.

MUST MATERIALIZE SOON.

There is not the least doubt that this vision will come true, but if the best interests of this Province are to be served it must materialize to a very substantial degree within the next three years.

If it were possible immediately to secure the active co-operation of the Federal Government, it might still be possible not only to defer the immediate construction of auxiliary steam plants, but to defer the construction of another development at Niagara, and divert a sufficient portion of the funds necessary for this development to the St. Lawrence project.

It cannot be stated with authority whether the Federal Government of the United States will assist this project financially, but certain allied private interests in the United States are known to stand ready at any time to finance and build the Morrisburg development up to the limit of their 50 per cent. share of the power. Canada, on the other hand, has an enormous investment in the Welland Ship Canal, which will be almost entirely useless and unproductive until such time as deep draft navigation is provided between Lake Ontario and Montreal. This same statement applies with almost equal force to the millions being spent on the Toronto Harbor. For these reasons alone, apart from the broad fact that navigation improvement on the St. Lawrence is for the general advantage of Canada, and not in any sense exclusively for this Province, it is reasonable to assume that the Federal Government of Canada will assist somewhat in the financing of this project by assuming a fair share of the cost on behalf of navigation.

CALL FOR IMMEDIATE ACTION.

Therefore, if the Federal authorities at Ottawa will reciprocate the advances recently made by Washington, immediate steps could be taken to put under way at Morrisburg, the logical first stage of the ultimate contemplated scheme of canalization and hydraulic development, embracing a power development of 600,000 horse-power and lockage facilities for 30-foot draft navigation. Half of Ontario's share of this power could be absorbed im-

mediately by the Central Ontario and Niagara Systems, thus temporarily providing a base load which would place the scheme forthwith on a commercial basis, and serve the further useful and essential purpose of deferring the construction of the second development at Niagara pending an enlargement of the present treaty restrictions, and until such time as a demand had been developed in western Ontario, through the use of St. Lawrence power, which would immediately absorb all preliminary carrying charges when the second Queenston development was ready for operation. Thereby would also be provided facilities for the reciprocal interchange of power between the Niagara and the St. Lawrence, which would ensure a very great saving to both systems, through the permissible curtailment of an otherwise necessary investment in non-productive spare capacity.

CAN REALIZE GREAT AIM.

Such is the bare outline of a problem which, serious though it may be, is susceptible of an ideal solution by means so simple as to require no argument beyond the bare recital of facts, and lacking only the friendly co-operation, and a small measure of financial assistance from the Federal authorities to effect its rapid realization. Lacking such co-operation, the Hydro-electric Power Commission will be reluctantly forced to inaugurate the use of auxiliary steam power twenty to twenty-five years in advance of its logical and proper time.

In connection with the intensive study of the steam-power problem which the commission's engineers are now making, careful consideration will be given to the practical and economic possibility of establishing auxiliary steam plants.

In any event, the outstanding fact is that the Ontario Hydro-electric System is to-day facing a crisis as serious as any in its past history, and one or other remedy must be applied without delay. Borrowing the expression used by a famous British statesman during the World War—"We must go onward, or go out."

—The Globe.

Hydro Holds Lead in Big Record Year

By F. C. MEARS

IT has been another big year for hydro-electric development in Canada. During 1923 there has been an addition of at least 250,000 horsepower to the country's total installation, as compared with 240,000 in 1922, while the aggregate water power development actually in use or available for use in the Dominion at the end of 1923 is 3,255,000 horsepower. A large number of projects are now in process of construction or actively in prospect which when completed will add 750,000 more horsepower to Canada's industrial strength.

Hydro's Great Achievement.

In Ontario the development work of the Hydro-electric Power Commission of course, ranked first. At the commission's gigantic Queenton plant on the Niagara River two new 55,000 horsepower units, 5 and 6, were brought into operation. It is expected also that units 7 and 8 will be installed by 1925, which will bring the capacity up to 440,000 horsepower, the ultimate total being 550,000 to 600,000 horsepower. A new 20,000-horsepower unity was installed in the Ontario Power Company's plant operated by the commission at Niagara Falls, this unit replacing a similar one which was destroyed in 1921.

A new plant of 1,200 horsepower was constructed at Bingham Chute on the South River, to serve the Nipissing system, and work was started on the installation of a new pipe line at Eugenia Falls. On the Trent River construction was commenced on two new developments at Dams 8 and 9 of 6,600 horsepower and 4,800 horsepower respectively. These will serve the Central Ontario system and are expected to be in operation in 1924. Operations were also begun on the addition of two new units of 12,500 horsepower each in the Cameron Falls station on the Nipigon River, to serve the Thunder Bay system.

In Northern Field.

In the mining district of Northern Ontario the Northern Canada Power Company brought into operation its 8,000-h.p. plant at Sturgeon Falls, on the Mattagami River, to serve the gold mines in the Porcupine area. The Great Northern Power Company also brought into operation its station at Indian Chute, on the Montreal River, with two units of 2,000 h.p. each. This company plans to add a similar unit in 1924. Construction was started on a 25,000-h.p. development by the Hollinger Consolidated Gold Mines, Limited, at Island Falls, on the Abitibi River, with the expectation of delivering power at the company's mine and mill in 1924. The Spruce Falls Company completed a 2,500-h.p. development at Kapaskasing, on the river of the same name, for use in connection with a sulphite pulp plant at that point. In the Kenora district the Backus-Brooks Company installed two additional 1,200-h.p. units in its plant at Kenora, and, with four more of the same capacity installed early in 1924, the station will have a total capacity of 12,000 h.p. for use in connection with the company's pulp and paper mill. The Dryden Paper Company also completed an installation of 1,400 h.p. on the Wabigoon River.

Among the power development works in Quebec was the addition of two units of 11,300 h.p. each by the Montreal Light, Heat and Power Consolidated to its St. Lawrence River plants at Cedars, with two more units to be added in 1924, bringing its total development up to 200,000 h.p. The St. Maurice Power Company expects to be able to deliver power from its new 120,-

000-h.p. development at La Gabelle, on the St. Maurice River, in 1924. The Southern Canada Power Company has awarded the contract for a 30,000-h.p. plant at Hemming Falls, on the St. Francis River.

Of great importance to hydro-electric development in Quebec is the work of the Quebec Streams Commission, which has carried out large storage works such as the Gouin Reservoir on the St. Maurice River, the Allard Reservoir on the St. Francis River, and the reservoir on the St. Anne de Beaupre River. It is now engaged on a $2,500,000 dam at Lake Kenogami, in the Saguenay district, which will beneficially regulate the flow on the Chicoutimi and Au Sable Rivers, to the advantage of the pulp and paper interests at Chicoutimi and Kenogami.

Steady progress was made during the year in the expansion of hydro-electric development in the Western and in the Maritime Provinces.

—The Globe.

Conference at Ottawa on St. Lawrence Power Undertaking

THIS St. Lawrence River power development is regarded by the Government as one of the most pressing problems of the hour, this fact being made manifest by the presence here of all the members of the Cabinet who are in the city, and also by our decision to carefully consider it at the very next meeting of the Cabinet, which will be held tomorrow."

This announcement by the Prime Minister, in replying to the eloquent representations from spokesmen of the Hydro-electric municipalities of Ontario, evoked loud applause from the 200 people gathered in the Railway Committee Room of the Parliament Buildings this morning, (January 11th.)

It was the largest delegation which has visited the Capital for a long time. Numbering nearly 200 persons, it represented the Ontario Hydro-electric Municipalities' Association.

The speakers, who were introduced by G. N. Gordon, Deputy Speaker of the House of Commons, included Mayor Maguire, J. Hilliard, ex-M.P.P., of Morrisburg; P. W. Ellis, Chairman of the Toronto Transportation Commission and the Toronto Hydro-electric Commission; ex-Mayor Charles E. Tuson of Windsor, Mayor Jutten of Hamilton, T. N. Stinson, Secretary of the Central Ontario Municipal Association, and Mayor W. Breithaupt of Kitchener.

Premier King, replying said the Government, by the presence of its members, had endeavored to show that it regarded the question of Hydro development as one of the most important before it at the present time. "We are anxious," he

went on, "to be as fully informed on all aspects of the question as may be possible. I think that quite as important as having the Government fully informed is that the public should also be fully informed on this subject and what it involves." Mr. Maguire had said it would be easy to bring all interests into harmony. "I will say this," added Mr. King, "that if Mr. Maguire will bring all the different interests here the Government will lose no time in acting."

One of the greatest difficulties in Government, the Premier proceeded was in reconciling different interests. There were the relations of the Provinces among themselves, the relations of the Provinces to the Domminion, relations with the State Government of the United States and relations between Canada and the Government of the United States, but what the Government could do to harmonize diverse interests would be done.—The Globe.

It is reported that the Dominion Cabinet met on the following day when most of the time was devoted to the discussion of the dual question of the development of power on the St. Lawrence River and of the proposed plan of deepening that waterway. Careful consideration was given to the representations made by the large deputation that had appeared before the Government on the previous day and also by Sir Adam Beck a few days before. As a result of these discussions a memorandum is to be prepared, upon which will be based a communication with the United States Government.

Gasoline Engine Driven Pumps at Brockville Waterworks

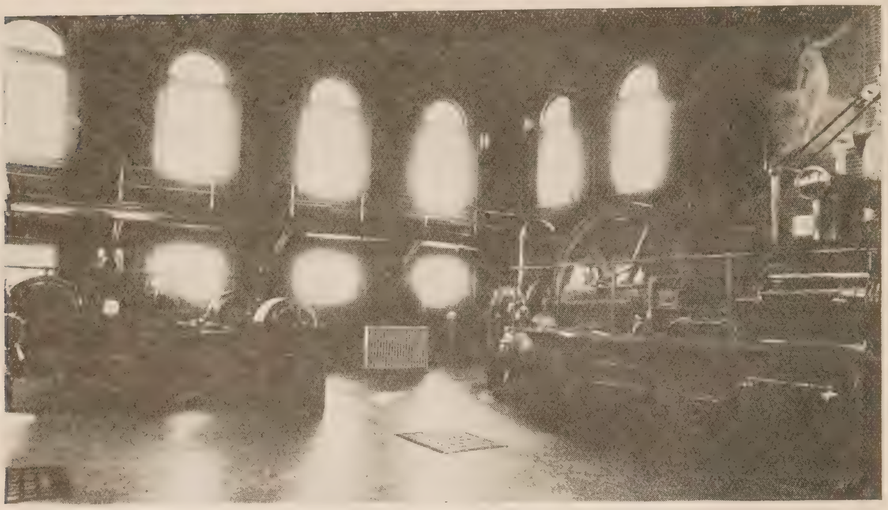
By V. VOADEN

Assistant Engineer, H.E.P.C. of Ontario

DURING the past year two gasoline engine driven pumps have been installed at Brockville Waterworks. The reason for installing this equipment, and some of the technical features of the pumps and the engines which drive them, should be of interest to the readers of the Bulletin.

The pumping equipment previously consisted of two reciprocating steam pumps, one of 3,500,000 and one of 1,500,000 Imperial gallons per day capacity. In addition there were two centrifugal pumps, one driven by a 200 horsepower synchronous motor and the other by a 125 horsepower induction motor. The latter pump could also be driven by a steam turbine by inserting bolts in a coupling on the extended pump shaft.

The electric pumps discharge into the street mains directly as there is no elevated tank or reservoir in which water may be stored. In the event of electric power being cut off it was necessary to start a steam



Centrifugal Pumps and Reciprocating Steam Pump now in Reserve

pump, and consequently steam pressure was maintained at 40 lbs. on one of the boilers at all times so as to be available in case of emergency.

It is interesting to note in passing that during 1923 the electric shutdowns totalled 45 hours and 32 minutes, of which 6 hours and 56 minutes were for trouble and 38 hours and 36 minutes were voluntary for repairs to the transmission line. Steam was used for 44 hours and 43 minutes.

It was found that the cost of the coal required to keep up steam pressure was a considerable item, amounting in 1923 to $7,657.20 (including coal for steam power plant). This led to an investigation of possible economies through installing gasoline engine driven pumps for standby service and so eliminating the consumption of all or nearly all of the coal. Generally speaking this is becoming standard practice for municipal pumping stations where hydro-electric energy is available, excepting in the case of larger cities where certain economies may be affected by a combination of electric and steam power so as to reduce the electric peak load for the municipality.

With the gasoline engine driven pumps installed, it is expected that the coal bills each year will be reduced by $6,000. This is seen to compare very favorably with the installed cost of the two gasoline engine driven pumps which was approximately $13,000.

In addition to the above saving, the fireman in charge of the boiler will be available for other duties.

There is also the advantage that the gasoline engine driven pumps can be put into full operation in a much shorter time than the steam pumps. With the latter about one-

half hour is required to bring the pressure from 40 lbs. up to the 125-150 lbs. at which they are operated. During the tests on the gasoline engine driven pumps both units were brought into full operation in less than three minutes.

The two gasoline engine driven pumps are alike. The specifications for each unit are as follows:—

The pumps are horizontal, centrifugal, two stage. The capacity when pumping against 90 lbs. domestic pressure is 2,450,000 Imperial gallons per day and when pumping against 110 lbs. fire pressure the capacity is 2,000,000 Imperial gallons per day for each pump with a suction lift of 16 feet. Each pump operates at 1400 revolutions per minute and is directly connected to its engine with a flexible coupling. Both are mounted on a common base. Each engine is a Model G.R.C.-6 as made by the Sterling Engine Co., Buffalo, N.Y., rated at 225 horsepower at 1500 revolutions per minute and is complete with storage battery, starting motor, and generator.

Tenders were obtained and in due course the contract for the two units was awarded to The Goldie & McCulloch Co., Ltd., of Galt, Ontario, the lowest tenderer, at $10,727.

The pumps were tested at the factory before being connected to their respective engines. Each pump was in turn connected to a direct current test motor, the efficiency of which was known. The guaranteed efficiency was 74 per cent. The actual efficiencies at the time of test, when bearings and parts were new, were 72.8 per cent. for one pump and 73.2 per cent. for the other pump, and as these were within the plus or minus 2 per cent. margin provided for in the contract, the efficiencies were considered satisfactory. It was found, however, that the pumps were both capable of giving somewhat more pressure than originally specified, and on this

Steam Turbine and Electric Motor Driven De Laval Pumps

account it was decided to operate at 1375 revolutions per minute instead of 1400.

The gasoline engines were also tested at the Sterling Engine Co.'s factory at Buffalo, when each engine developed continuously for one hour the maximum load of 185 horsepower which its pump would impose. In addition each engine was operated for 15 minutes at 1100, 1200, 1300, 1400 and 1500 revolutions per minute at the maximum load of which it was capable. The performance was satisfactory and checked very closely with the manufacturer's horsepower curves.

Certain features of the installation at Brockville merit attention and will now be dealt with in turn.

The pumps are primed with water taken from the main into which they discharge. As the pumping station is situated in the lowest part of the city, there should always be water available from the mains for priming, provided of course, that the foot value on each suction line holds.

Water is taken from the St. Lawrence River through an intake pipe extending some distance from the shore. The water is chlorinated in this pipe and then enters a well. A suction pipe with foot-valve conveys the water to each pump. The pumps discharge into a 16-inch cast iron main which carries the water to a steel header from which water mains lead to the various sections of the city.

Gasoline for the engines is stored in an underground tank of 500 Imperial gallons capacity outside the building. Inside the building is a gasoline pump of the service station type which pumps one gallon of gasoline per stroke from the storage tank to two small auxiliary tanks on a shelf near the pumps. From each auxiliary tank there is a gasoline pipe leading to the pair of Stromberg carburettors on each engine. The crankcase breather opens into the air intake leading to the carburettors. The quantity of gasoline vapor entering the cylinders is controlled both by the throttle lever and by the governor. The mixture is not pre-heated.

The exhaust pipes are 3½ inches in diameter. Special curved pipe, the shortest radius of which would be about 20 inches, was used instead of 45 or 90 degree fittings. Each exhaust pipe leads to an underground concrete exhaust box 8 ft. 0 in. by 4 ft. 6 in. by 3 ft. 0 in. located 10 feet away from the building, while a 9-inch tile pipe some 75 feet long conveys the gases away. It is found advantageous to run a portion of the cooling water, to the extent of the capacity of a ½ in. pipe into the exhaust pipes for cooling purposes and reduction of noise.

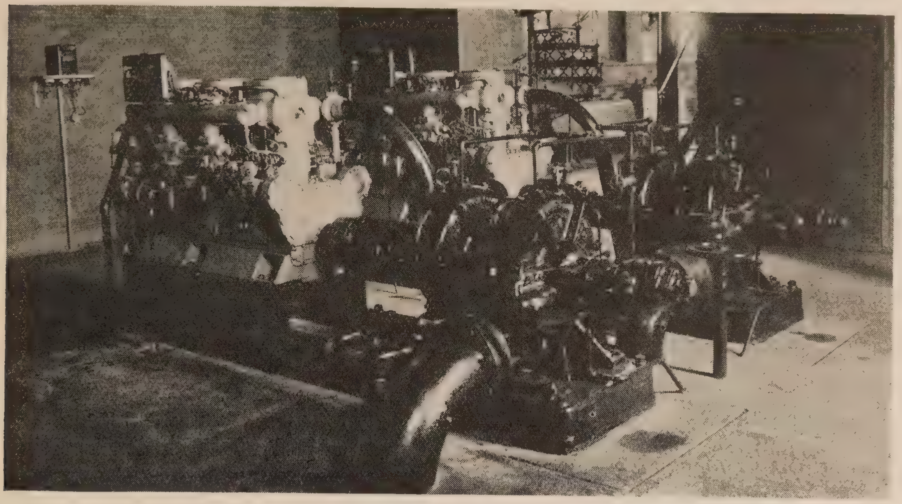
Cooling water for the engines is taken from the 16-inch main into which the pumps discharge. The course of the cooling water through each engine is as follows :—

(1) Circulating pump.

(2) Oil Cooler.

(3) Exhaust manifold (from which a portion is drawn off to cool the exhaust pipe).

(4) Cylinders.



Gasoline Engine Driven Pumps

(5) Inlet manifold.

(6) Overflow to drain.

The cooling water circulates about each cylinder throughout its entire length.

The starting and ignition systems are of particular interest. The starting system is similar to that on an automobile and consists of a 12-volt storage battery, electric motor and generator. The starting button and ammeter are conveniently located on an instrument board. The generator supplies a charging current of about 8 amperes.

Experience has shown that the short runs given frequently to ensure the engines being in condition for emergencies do not permit of the generator keeping the storage battery up to full strength, and therefore a Tungar Rectifier as made by the Canadian General Electric Co. was mounted on the wall near the pumps. Three switches were provided, one for the 110 volt single-phase 60 cycle power supply, and one for each of the circuits to each of the storage batteries so that either battery could be charged as desired. The charging rate is 3 to 5 amperes.

Power for ignition is supplied by the storage battery only, there being no magneto. Each cylinder has three spark plugs, the object being to secure rapid combustion of the fuel in the cylinders. This is particularly necessary on account of the high speed at which the engines run. There are three coils each with its own distributor. From each distributor, there are six wires, one to a spark plug on each of the six cylinders. Thus, if one coil or its distributor were out of order there would still be two

spark plugs per cylinder in operation. The spark may be retarded or advanced in the usual way by a lever connected to the distributors. When running at normal speed the spark is advanced so that the explosion occurs when each piston is within 9/16 inch of the top of its stroke. The firing order is 1, 4, 2, 6, 3, 5, cylinder number one being at the flywheel end.

On account of the high speed at which the engines run special provision is made for the admission and exhaust of the gases. Each cylinder has two inlet and two exhaust valves. They are located over the top of the cylinder and are operated by rocker arms from two camshafts in the crankcase, one on either side.

The lubrication is automatic. Oil is pumped from the crankcase through strainers, and is cooled and forced to all bearings. A relief valve permits the pressure to vary from 25 to 40 lbs. depending on the load. The oil pressure is shown by a gauge mounted on the instrument board while a float indicates the oil level in the crankcase.

After installation the two units were given a thorough test. Lines of hose with 1⅛ inch nozzles were connected to hydrants near the pumping station, and with six fire-streams the pumps maintained a pressure at the pumping station of 110 lbs. The pumps were also supplying the normal domestic requirements at the same time, and neither pump was operating at its full capacity. Later on a test was made in a section of the city remote from the pumping station and with two fire-streams in operation, the pressure at the hydrant was 82 lbs.

The estimated cost, exclusive of building was $13,000 and the installation will be completed at approximately that figure. Since each pump is capable of delivering six standard fire-streams, the cost per fire-stream is approximately $1,100. We are satisfied this is the lowest figure at which reliable reserve pumping equipment can be installed to-day. This is confirmed by the practice of numerous municipalities, both in Canada and the United States. Among other installations in Ontario are those at Stratford, Strathroy, Barrie, Pembroke, Aylmer, Niagara-on-the-Lake, Markham and Alliston.

The gasoline consumption is about three-quarters of a pint per horsepower hour, and each engine at 185 horsepower load requires about seventeen gallons per hour.

Compared with electrical energy, these figures indicate a cost for fuel alone of nearly 3 cents per kilowatt hour under the most favorable conditions of continuos operation.

The Hydro-Electric Power Commission gave the municipality such engineering assistance as was required.

Dr. H. A. Clark is Chairman of the Brockville Public Utilities Commission, for whom the pumps were installed. Much credit is due to A. L. Farquharson, Manager for the Commission and to Wm. Chapman, Chief Engineer at the pumping station, who took charge of the work of installation.

Proposed System of Conduit Wiring with Bare Neutral

The system of wiring described herein has been proposed by a member of the staff of the Hydro-Electric Power Commission of Ontario . A description of this system has been sent out to many of the Hydro municipalities and various electrical associations asking for comments on it. Other readers will be desirous of commenting on this scheme and the Commission will be pleased to receive opinions from them. Those communicating with the Commission on this will kindly mark their letters for the attention of Mr. A. S. L. Barnes.—The Editor.

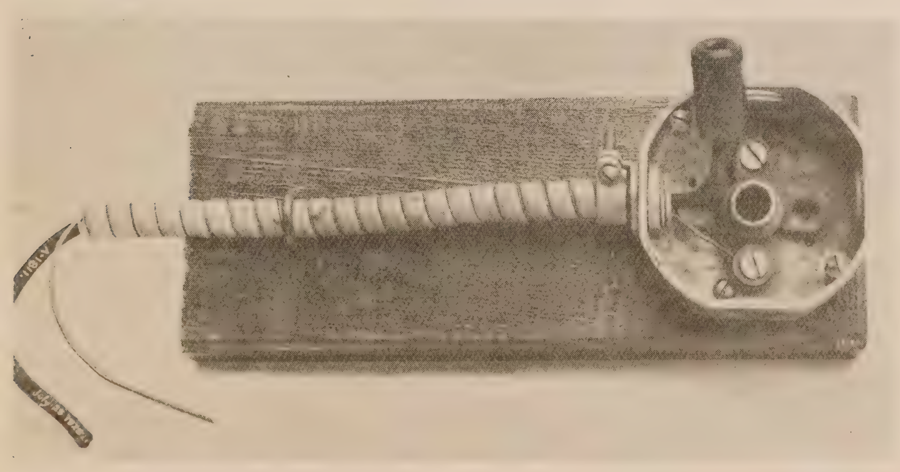
THE method of wiring herein described is a modification of conduit wiring (rigid or flexible) of either the draw-in or built-in type, but it is with flexible steel conduit that its advantages would appear to be the greatest.

Generally speaking, and taking flexible conduit as an example, the proposed method is in many respects the same as an ordinary flexible steel conduit system except that the neutral wire in a three-wire circuit, and the ground wire in a two-wire circuit, would be bare, and the internal diameter of the conduit itself could therefore be very considerably reduced.

The advantages claimed for this method are briefly as follows:—

(1) Simplicity of installation and of the inspection rules required to govern the work.

(2) Highly effective grounding, and bonding easily effected, since the bare grounded wire is permanently bonded at each and every outlet box, thus not only forming a permanent and continuous bond through each box but also overcoming the weakness of high resistance joints often present in conduit systems as a result of loose lock nuts, enamel or rust.



Outlet Box Assembly

(3) Installation of fixtures greatly simplified, inasmuch as the fixture stem is permanently grounded, the fixture when screwed to the stem is at once grounded, requiring only the making of one joint, viz:—the live or insulated wire which can, in most cases, be effected by means of a solderless connector. It is further possible to simplify matters by the adoption of a form of socket requiring only one wire in the fixture, the metal of the fixture and the socket being all part of the grounded side of the circuit. The present tedious, and often difficult, work of inspection would also be reduced to a minimum.

(4) There is not only a large saving in rubber insulation but the requirements for an identifiable grounded conductor is met in such an effective manner that it is practically impossible to make any mistake in distinguishing the identifiable wire.

(5) Owing to the relatively small cross section of the conduit required for this system, damage to buildings would be materially reduced, as not only would the holes in timbers be much smaller but their number would be reduced to half and sometimes a third of that now required in knob and tube work.

(6) The grounding of portable apparatus is rendered simple and effective.

(7) The substitution of this method of wiring in place of knob and tube work would greatly reduce the present variety of stock and materials now employed and would require fewer rules and regulations which, in turn, would tend to reduce inspection costs.

(8) The present risk of shock from metal fixtures, fittings, etc., in damp locations or in the vicinity of grounded surfaces would be practically eliminated.

(9) Existing buildings can be wired through smaller openings and wires can be fished without exposing them to injury. This method also insures continuity of protection from outlet to outlet.

It has been suggested that on the basis of the claims of simplicity, safety and economy made for this system it might be adopted as a standard method of wiring for use in this Province, thereby dispensing with knob and tube and open wiring, and that it will, in the very near future, cost actually less than such present methods.

At first sight it may appear as a somewhat drastic change from present orthodox systems, but reversing the present order of things, and assuming that knob and tube work did not now exist and that the proposed method was in effective use, and that it was proposed to introduce knob and tube wiring, with loom laid in wet plaster, open wires run under floors, fixed down

partitions and other spaces, in many places exposed to mechanical injury, difficult to inspect and often subject to future interference, it is not unlikely that a proposal to adopt knob and tube wiring would be viewed with apprehension. In other words, would it not be much more reasonable to object to the abandoning of the proposed method in favor of knob and tube work than to object to abandoning knob and tube work in favor of the proposed system.

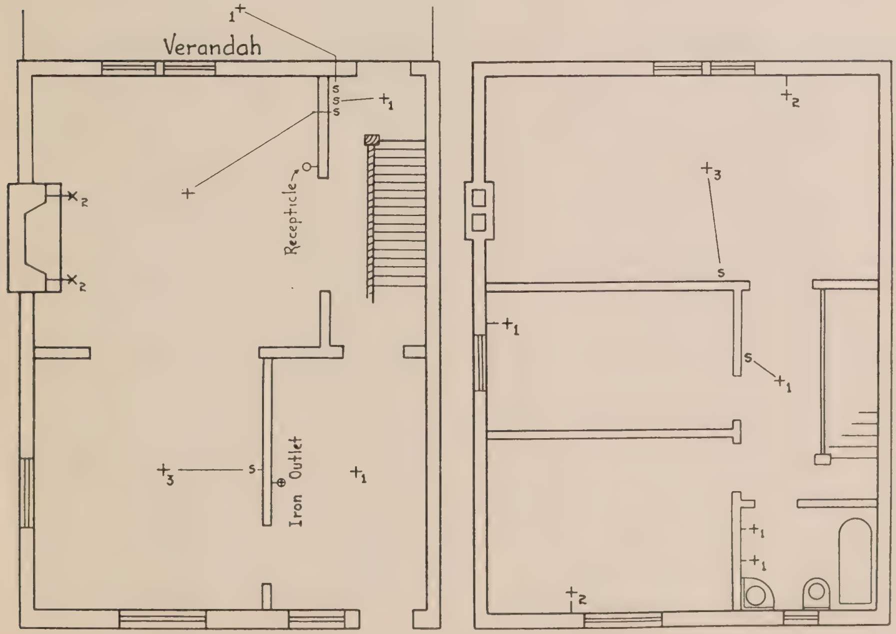
Finally, the estimates submitted indicate that the cost will, from the first, compare very favorably with, and will eventually be considerably less than, that of knob and tube work.

This will be brought about owing to greater demand for the tubing, improved and simplified fittings, and the saving in time that will result from experience in handling.

An estimate has been prepared on the cost of wiring an ordinary 6-roomed house (see plan attached). The estimate shows that the cost of a knob and tube job would be about $91.00, whereas the same house would cost approximately $83.00 if wired on the proposed system.

For purposes of comparison the estimates of the two methods of wiring are placed in parallel columns under the captions of "Knob and Tube System" and "Proposed Scheme" respectively. These estimates include all fixture work.

It will be noted that inspection of the fixtures is not included under



Plan of House Showing Wiring Estimated on.

Estimated Cost of Wiring a Six-Roomed House

Knob and Tube System

Quantity	Item	Value
Service—		
1	30 Amp. Service Box	$1.50
25 ft.	¾ in. Service Pipe	2.60
1	¾ in. F. Condulet	0.65
50 ft.	No. 10 R. C. Wire	1.50
2	Grounding Clamps	0.50
Installation—		
1000 ft.	No. 14 R. C. Wire	8.70
100 ft.	¼ in. loom	2.25
200	3 in. x 5/16 in. Porc. Tubes	1.15
200	1 in. Knobs	2.80
	Tape, screws, loom clips, solder, etc.	2.00
16	Outlet Boxes	3.80
8	Switch Boxes	1.60
1	Edison Cutout	0.71
1	3-Gang Switch Box	0.45
5	Switch Boxes	1.60
25	Key Sockets	4.75
	Wiring of Fixtures	5.00
Labour—		
	Wiring	40.00
	Installing Fixtures	5.00
Inspection—		
	Fee for Wiring	3.55
	Fee for Fixtures	1.00
		$91.11

Proposed System

Quantity	Item	Value
Service—		
1	30 Amp. Service Box	$0.80
25 ft.	½ in. Service Pipe	2.00
1	½ in. F Condulet	0.55
25 ft.	No. 10 R. C. Wire	0.75
25 ft.	No. 10 Bare Wire	0.15
2	Grounding Clamps	0.50
Installation—		
500 ft.	No. 14 R. C. Wire	4.35
500 ft.	No. 14 Bare Wire	1.15
400 ft.	Flex. Steel Conduit	21.40
16	Outlet Boxes	3.80
8	Switch Boxes	1.60
	Nipples for Boxes	0.75
1	Edison Cutout	0.71
1	3-Gang Switch Box	0.45
5	Switch Boxes	1.60
25	Special Key Sockets	3.80
	Wiring of Fixtures	4.00
Labour—		
	Wiring	30.00
	Installing Fixtures	3.00
Inspection—		
	Fee for Wiring	2.55
	Fee for Fixtures	0.00
		$83.91

the "Proposed Scheme" because it is assumed that this can be dispensed with, likewise an inspection fee lower than that at present charged is included for the wiring, on the assumption that this can, and will be, reduced.

As will be noted, credit is given the "Proposed System" for prospective saving on items such as sockets and service box. These articles, specially adapted for use with this method of wiring, are not now on the market but could be quickly developed. For instance, sockets could be greatly simplified since no precautions would be required to insulate outer shells as now required, and the cost of service boxes could be reduced to about 2/3 of the present cost.

This estimate is largely assumed as to cost of labor, as such work has never yet been actually performed, but it is probably well within the range of possibility.

RADIO RECEIVER AT NIPIGON

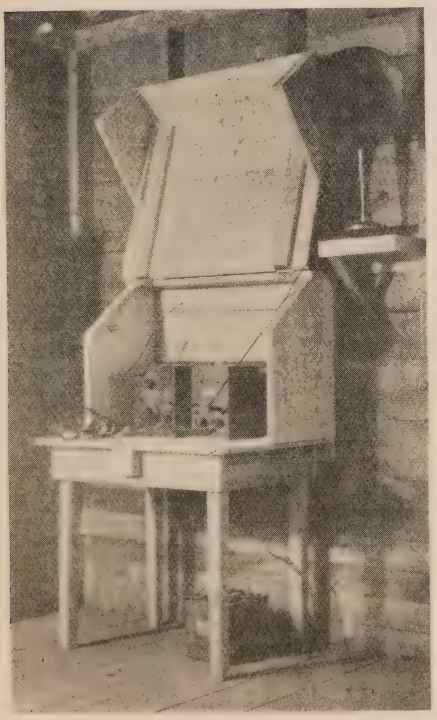
The readers of the Bulletin may be interested in a very sensitive radio receiver which has just been installed in the Recreation Room of the Construction Camp at Nipigon. To this set is attached a loud speaker which enables persons anywhere in this room to hear the broadcasts of the more powerful transmitting stations in the United States.

The receiver was first operated on the evening of Nov. 10, and received an Armistice Day Address by Ex-President Woodrow Wilson, broadcast from the radio station of the American Telephone and Telegraph Company in the city of New York.

On the following evening a complete church service, including the sermon was brought in from Pittsburg, also the latter part of a service from Regina, Sask.

In addition to the above, musical programmes and speeches are received every night from about thirty stations, including those in New York, Schenectady, Buffalo, N.Y., Pittsburgh,Pa., Chicago, Ill., Louisville, Ky., Kansas City, Fort Worth, Texas, Omaha, Neb. and Los Angeles, California.

The camp is now kept well informed on current events. Eastern Standard time signals are received at ten o'clock each evening and the musical programmes add much enjoyment to camp life.



Radio Receiving Set, Nipigon Camp

BRANDED

An electric specialty company has had a peculiar damage suit filed against it. The plaintiff's petition contains these words:

"Plaintiff alleges that this defendant represented to her that his range would not become heated on the upper surface. That plaintiff, relying wholly upon this defendant's representation, placed her bath tub in the kitchen near the range. That upon emerging from the tub, plaintiff's foot accidentally came into contact with the soap upon the floor and she was thus compelled to sit upon the range. That, although she arose therefrom in all diligence, she discovered she had been branded 'H-47'."

—Exchange.

Measurement Of Radio Aerial Capacity

By F. K. D'ALTON

Assistant Laboratory Engineer, H.E.P.C. of Ontario

IN the designing and adjusting of radio transmitters, it is essential that the electrostatic capacity of the aerial, as well as the resistance and induction, be definitely known. These may be estimated fairly closely but if direct measurements can be made, this is highly desirable.

Devices used for measurement of aerial capacity usually require that the aerial retain a small charge for a very short time, allowing the same to leak off gradually through a current indicating device, but where the aerial is placed in the proximity of power lines, it is at all times so highly charged by the electrostatic field that this method can not be employed.

The guided wave aerials installed on the Niagara System of the Commission are charged to a potential of several thousand volts when ungrounded. The addition of a further small charge, such as the ordinary measuring device would add, would be negligible and the indicator would function on the heavy charges induced on the aerial from the power lines.

The instrument that is used for measurement of the capacities of these guided wave aerials is practically a small continuous wave radio transmitter, which may be attached to the aerial (and ground) or other electrostatic capacity and from the measurement of the wave length of the radio frequency currents generated, the value of the unknown aerial capacity is computed.

This meter includes a capacity standard of .001 microfarad and gives a wave length of 1570 meters (normal for the guided wave sets) when the capacity being measured is .0028 microfarad. The guided wave aerials each have capacity of approximately this amount, so that in measuring the aerial we do so at a wave length close to normal and thus obtain the effective capacity

of the aerial under operating conditions.

The meter consists of a thermionic valve with suitable oscillating circuit, having the inductance coils in such position that the wave lengths may be easily measured with the wave meter a short distance away. A supply of filament current and also of plate voltage (200-1000 volts) are both necessary but these are available at all transformer stations where guided wave sets are installed.

The induced charges on the aerial are led to ground through a drain coil of high impedance at radio frequencies. There are no adjustments to the device other than the control of filament current and only one reading on the wave meter is necessary in the measurement of a capacity.

Fig. 1 shows the capacity measuring instrument in the centre with the .001 microfarad capacity standard at the left hand side and the wave meter a short distance away to the right. The arrangement of coils is such that a maximum flux exists at the right hand side of the measuring instrument and a full scale reading on the galvanometer is obtained with the wave meter about eight inches distant.

The aerial and ground leads are attached to the binding posts just behind the valve on the top panel and the sources of plate voltage and of filament current are connected to the binding posts appearing on the front of the instrument. A high frequency ammeter mounted on the top panel of the instrument indicates the value of aerial (charging) current.

The characteristic curve of this instrument, Fig. 2, indicates that the greatest accuracy can be obtained when the unknown capacity has a value between .0005 and .005 microfarad. The accuracy of measurement depends chiefly on the accuracy of the readings of the wave meter. With very small (unknown) capacities, the charging

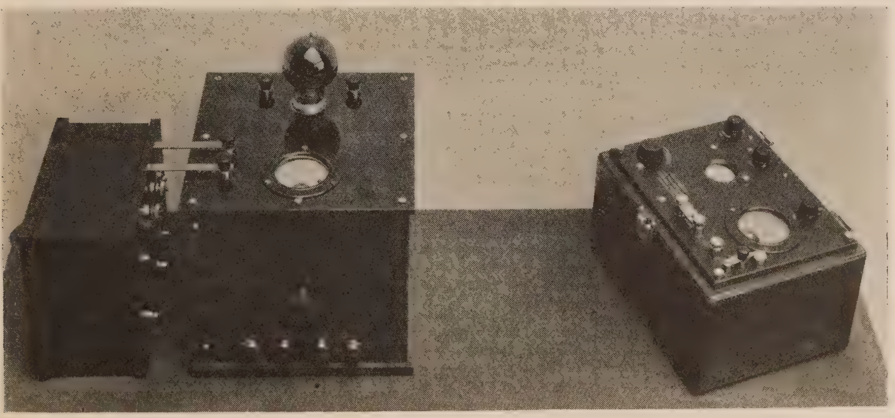


Fig. 1. Capacity Measuring Instrument (left) and Wave Meter (right)

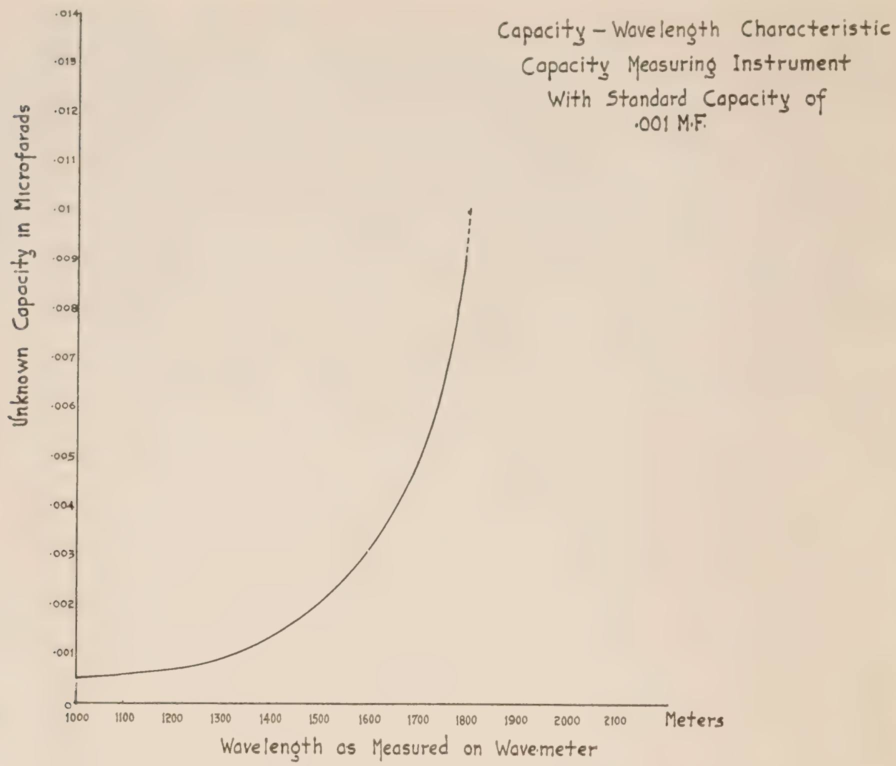


Fig. 2. Characteristic Curve of Wave Meter

current is small and may be so low in value that accurate readings on the wave meter are not obtainable.

Effective antenna resistance may also be measured by the use of this instrument, together with a non-inductive resistance standard.

Electric Light and Plant Growth

THE December, 1923 Bulletin described an experiment that had been made by the Laboratories on the effect of artificial light on plant growth. Similar experiments have been carried out elsewhere. The results as shown in the following report from The Globe are of more than passing interest since the experiments were carried out in green houses which permitted the control of both temperature and moisture.

That electric light accelerates the growth of plants was proved in a six-weeks' test recently completed by the Westinghouse Company. During the tests, which were conducted in co-operation with Peter Henderson & Co., seedsmen, at the Henderson proving grounds at Baldwin,

L.I., many of the specimens exposed to electric light grew to approximately twice the size of similar plants receiving daylight only, and were considered by experts to be from 14 to 27 days in advance of normal growth. Similar results were also obtained in preliminary tests conducted at Columbia University under the direction of Prof. Hugh Findlay. Two 110-volt farm lighting plants were used to supply the power for the Baldwin experiments.

On September 1, 12 varieties of vegetables and 12 of flowers were sown in flats. The soil used was ordinary light, sandy soil such as is generally used for starting seedlings. Two sets of flats were sown, one set for growing under artificial light and the other for growing with daylight only.

Both sets were grown under identical conditions of heat and moisture on opposite benches. When the electric lights were turned on an oilcloth curtain divided one group from the other. The light was switched on every night at 8 o'clock and shut off automatically at 1 o'clock.

"Almost from the outset," reports J. A. Fiesler of Peter Henderson & Co., "there was a marked difference noted in the germination of the seedlings under the electric light. Germination was hastened in some cases, as in the beans, celery, lettuce and endive among the vegetables and calendula, gysophila (baby's breath), antirrhenium (snap dragon), mignonette and wallflower among the flowers, to the extent of four to twelve days, depending on variety. The advantage gained with the advanced germination was maintained in every case through to the end of the experiment. In some cases there was no perceptible gain in growth, particularly in the root crops, including beets, carrots and radishes."

The plants so treated were not spindly, but presented a stockier richer appearance than the others. Those varieties with a large leaf surface seemed to derive the greatest benefit.

Principles of Illumination

By G. R. ANDERSON

Professor of Engineering Physics, University of Toronto

Synopsis of talk before The Toronto Chapter of the Illuminating Engineering Society, December 10, 1923

IT may be truly said that the utilization any people make of the methods of illumination at their disposal is a measure of their state of civilization. That this is true will be apparent from the fact that the major portion of our knowledge of the world and what it offers to us is acquired through the sense of vision. The ancient civilizations of Egypt, Babylonia, Persia, as well as the later civilizations of Greece and Rome, all of which we are accustomed to denominate as pagan, realized the extreme importance of light and made the sources thereof objects of adoration. The names of our first two days of the week are a constant reminder of the dedication of these days to the special worship of our sources of natural light.

In all the various forms of religion of the mediaeval and modern world, light plays an important part in the ritual. And although it would be wrong to say that light is now an object of worship, yet it symbolizes that which we do worship.

If then light is of such paramount importance it follows that every one who aspires to be a good citizen should possess at least a knowledge of the fundamentals. It is only the criminal who loves darkness rather than light because his deeds are evil.

From the scientific side also light is of supreme importance. Light is the great enemy of dirt and disease and now-a-days is perhaps the cheapest commodity that we have.

What then are the fundamentals of the subject?

1. Light in sufficient quantity.
2. Light of the best quality available.
3. Light properly distributed.
4. The sources adequately maintained.
5. Care of the eyes.

It is obviously not necessary or even desirable that the general public be made acquainted with the details of photometers, polar curves, coefficients of utilization and such like technical data. These are the province of the Engineer in general and the Illuminating Engineer in particular, but a grasp of the underlying principles is within the reach of every one with a sound secondary education and such should form a part of the curriculum.

To be specific, the artizan, the man or woman engaged in industry should have sufficient knowledge to protest when an atrocious scheme

of lighting is forced on him by an employer through ignorance or false economy. So often it is the case that a worker is compelled to sit or stand at a machine for several hours daily with an unshaded clear lamp directly before him. The employer or manager has perhaps provided sufficient light but his plan of distribution is all wrong. The clerk or stenographer who spends all his or her working time at a desk, perhaps highly polished, partly covered with white paper, perhaps of the glossy variety, is very frequently the victim of bad lighting both natural and artificial. The desk is quite likely to be so placed that the person sitting at it faces a brightly lighted window and when the daylight fails a desk lamp is utilized so placed that specular reflection takes place directly into the eyes of the worker. Is it any wonder that these people suffer from eye troubles and have headaches daily?

The merchant, whether he keeps a corner grocery in a rural town or is proprietor of a mammoth departmental store in a metropolitan city, should know that light is his best form of advertisement. It enables him to display his goods to the best advantage, it attracts passers-by to look in and everyone who stops to look at a window display or an interior is a prospective customer. It promotes cleanliness and order which are potent attractions to a purchaser; no one wishes to shop in a dingy, dirty, badly lighted store. It enables the clerks to work to advantage and in comfort. Obviously then the merchant should have a knowledge of the fundamentals of good lighting.

The manufacturer if from the standpoint of self-interest only will see to it that adequate lighting is provided throughout the works. Five minutes' time wasted by every employee in a factory through faulty lighting will pay the cost of a proper system of illumination. Not only will the output be increased but the wastage due to imperfect workmanship will certainly be greatly reduced and the workmen will be more contented, a matter of no small moment in these days of labor troubles.

The professional man should have some knowledge of the subject, whatever his profession may be. The doctor whose province it is to conserve the health of the community, if he has a fair knowledge of the basic principles, will be in a position to condemn bad lighting wherever he finds it. His own office will be properly lighted so that he may do his work with certainty and the hospital will be lighted so as to secure comfort for the patients and convenience to those who wait on them. The dentist whose work is closely allied to that of the doctor also requires the best of lighting in his office and laboratory. In the office much depends on the color of the teeth and gums and it is impossible to examine these carefully under poor lighting conditions. In the laboratory the matching of artificial teeth requires either good daylight or its equivalent. The clergy-

man concerned mainly with giving spiritual light should at least know a little of the basic principles of natural lighting. Teachers of whatever grade should certainly have a good knowledge of illumination in order that they may be able to protect the eyesight of children under their care. Undoubtedly it is a fact that the cause of so much defective eyesight rests on conditions encountered during school days. The teacher can do much towards instructing the pupil in the best way of utilizing the light by which he studies and in avoiding improper placing of lights. He or she can also see to it that as far as circumstances permit light is properly controlled in the school room.

Architects as a class are generally concerned mainly with the design and construction of buildings and are too often prone to neglect three things that tend to the comfort and satisfaction of those who occupy them. These are the ventilation, acoustics and lighting; with the first two we are not here concerned but a word or two may be said of the lighting. Quite too often the architect constructs a building which should be a source of satisfaction to all concerned and then leaves the lighting to a dealer in equipment to look after, which dealer may or may not have any knowledge of what will suit the conditions. Either the architect should know the subject thoroughly himself or he should be prepared to employ some one who does. Many otherwise beautiful public buildings are largely spoiled by bad lighting. Why architects are so indifferent to the possibilities of the effects incident to good or bad lighting must be because the matter has not been brought to their attention with sufficient force.

The last class that I will mention is the lady of the house. Surely it is worth while to obtain lighting in our homes that will be as good as the purse of the owner will permit. On the contrary it very often happens that costly and elaborate affairs are installed which are not only needlessly expensive but are entirely out of harmony with the surroundings. Lighting in homes should be partly decorative but it should be simple rather than ornate and should be efficient. Further the bearing of the wall decoration on the appearance of the lighted room should ever be borne in mind.

Other illustrations will occur to the minds of all of you but I have said perhaps enough to show the great importance of a knowledge of the subject to all classes of the community. How much or how little each individual knows will depend on his or her opportunity, but to us as members of the I.E.S. is entrusted the task of carrying the light of knowledge to those who are in darkness, let us put the opportunity before them and hope for the best. Let each member of this society be an apostle of good lighting and let us remember that like the apostles of old we will encounter difficulties and discouragements but that success will ultimately come if we persevere.

Hydro News Items

Central Ontario System

The Local Commission reports a total of 74 contracts signed in the Village of Warkworth. An extension is being made to the distribution system to take in a suburban area north of the Village.

* * *

Satisfactory progress is being made on the new municipal substation in Peterboro. The Utilities Commission are completing the rearrangement of the distribution system for service from the new substation.

* * *

Eugenia System

The Commission has completed arrangements with the Hanover Cement & Stone Limited for obtaining 500 h.p. from the two hydraulic plants of that company to supplement the power supply of the Eugenia System. For approximately nine months of the year this company is a customer of the local Commission of Hanover to the extent of about 600 h.p. the balance of its power requirements being obtained from two hydraulic generating plants. As the company does not operate during the winter months and as a low water period occurs on the Beaver River water shed during that portion of the year, this arrangement enables the Commission to conserve the storage at Eugenia to a better advantage.

* * *

Niagara System

The Kitchener Light Commissioners opened their new office building on December 19th last, and are to be complimented on the good judgment they have shown in connection with the location of the building, and the manner in which it has been equipped.

* * *

The Town of Sandwich passed a Money by-law at the municipal elections on January 7th to provide sufficient money to take over the ownership of the local distribution system, which, up to the present time, has been financed partly by Windsor Hydro-Electric System, and partly by the Hydro-Electric Power Commission of Ontario. The Sandwich system has been operated by the Windsor Hydro-Electric System for the past eight years.

* * *

The Towns of Leamington, Kingsville and Essex voted on Hydro Enabling and Money by-laws at the municipal elections of January 7th to provide for taking over the ownership of the local distribution systems, and entering into standard agreements for power supply with the Commission. These by-laws carried by about ten to one. These

systems have been operated by the Commission as a separate system since they were purchased by the Commission from the Essex County Light & Power Company in 1918. It is expected that Amherstburg and Harrow will submit similar by-laws within the next few weeks.

* * *

The sixth generating unit at Queenston was put into operation on January 6th. Units seven and eight have been on order for some time and will be installed and in operation before the next winter's peak. Unit number six was installed in approximately one year from the date of authorization of purchase.

* * *

A temporary 110,000 kv. connection has been affected across Burlington Beach, greatly increasing the flexibility and efficiency of operation of the high tension system.

* * *

Rideau System

The Kemptville Milling Company has removed all its poles and wires from streets of Kemptville, and the village is now in the undisputed possession of its streets for the first time in 30 years.

* * *

The Smith's Falls' Commission is considering the renewal and operation of the old power plant at Slys Rapids.

* * *

Severn System

Service was given to the International Fibre Board Company by the Local Commission at Midland on Sunday, January 13th, through a separate substation.

The initial load of this concern will approximate 600 h.p and will be increased to 1200 h.p. in two or three months' time. The company is also making provision to install an additional grinder which will increase their total demand to about 2,000 h.p. Saw mill refuse which heretofore has been disposed of by burning will be utilized to obtain ground wood pulp which forms the basis of the company's product. The magnitude and importance of Midland's industrial progress is manifest by the fact that this substation constitutes the fifth of its kind in that municipality.

* * *

St. Lawrence System

A Company, formerly located in Ottawa, has purchased property in the Town of Alexandria, and is installing machinery to manufacture tinware. Its demand, including an electric welding outfit, will be about 30 h.p.

* * *

Estimates have been submitted to the Council of the Township of Cornwall, on the cost of service to rural residents of the Township.

* * *

The Council of the Township of Williamsburg, has entered into an agreement with the Commission, to supply electric power to rural residents of the Township.

List of Electrical Material, Devices and Fittings

Approved by The Hydro-Electric Power Commission of Ontario in December 1923.

Appliances

RENFREW ELECTRIC PRODUCTS LIMITED, Renfrew, Ont.

Curling Tong Heater.

* * *

FINDLAY BROS. CO. LIMITED, Carleton Place, Ont.

Cabinet Type Electric Cooking Range "Findlay".

* * *

FESS OIL BURNERS OF CANADA LIMITED, 47 King St.. West, Toronto.

Motor-Operated Oil Burning Furnace.

* * *

THE OTTO HIGEL CO. LIMITED, 680 King St., West, Toronto.

Electrically-Operated Pianos.

* * *

CANADIAN GENERAL ELECTRIC CO., LIMITED, Hotpoint Works Division, Stratford, Ont.

Immersion Type Water Heaters, Cat. Nos. W. 40, W. 41 and W. 42.

* * *

HOLDEN-MORGAN LIMITED, 579-585 Richmond St. W., Toronto.

Motor-Operated Oil Furnace.

* * *

*WESTINGHOUSE ELECTRIC & MFG. CO. (Mfr.,) East Pittsburg, Pa.

CANADIAN WESTINGHOUSE COMPANY, LIMITED (Submittor), Hamilton, Ont.

Rectifiers, Types AA-automatic, AN-non-automatic, AT, AL, "Rectigon" and No. 282395.

*CHRISTIAN ELECTRIC MFG. CO., THE, 2503 Isabella Ave., Detroit, Mich.

Water Heaters.

* * *

CANADIAN GENERAL ELECTRIC COMPANY, LIMITED, Hotpoint Works Division, Stratford, Ont.

Hot Plates "Hotpoint", Cat. Nos. D. 20 to D. 26. incl.

* * *

THE LAUNDRYETTE MANUFACTURING CO., 1190 East 152nd St., Cleveland, Ohio.

Washing Machine.

* * *

RENFREW ELECTRIC PRODUCTS LIMITED, Renfrew, Ont.

Portable reflector type Air Heater, Cat. No. 3.

* * *

JAMES H. RODEN, 217 Grenadier Rd., Toronto.

Electric Gas Lighter.

* * *

*WATERS-GENTER CO., 20 N. 2nd St., Minneapolis, Minn.

Automatic Toasters.

* * *

*DICTAPHONE CORPORATION, THE, (Mfr.), Bridgeport, Conn.

DICTAPHONE SALES CORPORATION, LIMITED, (Submittor), 33 Melinda St., Toronto.

Dictating Machine.

Shaving Machine for Dictating Machine Cylinders.

* * *

*GILBERT Co., THE A. C., (Mfr.), Blatchley Ave., New Haven, Conn.

A. C. GILBERT-MENZIES Co., LIMITED (Submittor), 439 King St. W., Toronto.

Air Heater, Cat. No. B-90.

Hair Dryer "Polar Cub Type G".

* * *

SMITH AND STONE LIMITED, Georgetown, Ont.

"S-S" Porcelain Split Knobs.

* * *

*GORDON ELECTRIC MFG. Co., THE, Waterville, Conn.

Plug Fuse Cut-out Bases, "Gordon", Cat. Nos. 1935, 2135, 2165, 2199, 2569, 2587, 2965, 8042, 19350, 21990, 25870.

* * *

THE CANADIAN GENERAL ELECTRIC COMPANY, LTD., 224 Wallace Ave., Toronto.

Medium Base Receptacles, Cat. Nos. G. E. 294A, G. E. 295A.

Medium Base Sockets, Cat. Nos. C.G.E. 144, C.G.E. 244.

* * *

SQUARE D COMPANY, (Mfr.), Detroit Mich.

SQUARE D COMPANY, (Submittor), Walkerville, Ont.

Cutout Bases-Plug Fuse, Cat. Nos. 1021, 1025.

* * *

*BRYANT ELECTRIC Co., THE, Bridgeport, Conn.

Medium Base Sockets, Cat. Nos. 4202, 4207, 4212, 4477-79 incl., 4499, 4514, 4043-44, 4203, 4208, 4213, 7402, 7404, 7406, 7408, 7410, 9392, 43390, 50768, 99392, 46750-52 incl., 50766, 66237, 4004, 4205, 4210, 4215, 43311-12, 42686, 43310, 43313-14, 60666, 4041, 4056, 4106-07, 4137-44 incl.

Porcelain Shell, Cat. Nos. PA-PG incl., PP, PT, RW, 73, 76, 71, 4235, 9448, 9496, 399, 9366, 50997, 4034.

Receptacles for Attachment Plugs and Plugs. Cat. Nos. Receptacle 130, Cap KR, Caps KA to KD incl., KG, KJ, KK, KM, KN, MA to MD incl., MG, MJ, MK, MM, MN, 128, 138, Cat. No. 584 receptacles, Cat. Nos. 586, 588 plugs; 583, 585, 587, 546, 1708, covers 547-48; 308-09, 393-94, 411, 411-Sp, 507, 508, 507-Sp, 1508-09 combination switch and receptacle 509, with plugs 375, 1510; 430, 630, with plates 431, 489 and plugs 432, 490, 494, 539, 594-95, 475 with plugs 476, 497-98, Receptacle 2520, mechanism 2528, plug 2567. Spartan Cat. Nos. 29, 29-A, 79, 104-116 incl., 120, 122-25 incl., 126, 127, 129, 9020, 9022, JS-721, 733; 1363 with plugs 397, 486, 1110; 556, 621-2, plugs 623, 652-3, 341-42 with plug 343 and sub-base 344, 446-48 incl., BZ, mounting rings, Nos. 304-05, 615.

Fuseless Attachment Plugs, Cat. Nos. 499, 500, 1948, 3284, 3286, 3530, AV-12, AV-34, AV-35, AV-22, 699, 700, KA to KE incl., KG, KJ, KM, KN, MA to ME incl., MG, MJ, MM, MN, W,P-21, 103, KT-130, 345.

* * *

Switches

*SUNDH ELECTRIC Co., 5 Avenue C, Newark, N.J.

Automatic Switches—Float Type, Types A, B, C, D, E.

Automatic Switches — Pressure

Operated Type, No. 4900.

* * *

*JOHNSON SERVICE CO., (Mfr.), Michigan & Jefferson Sts., Milwaukee, Wis.

JOHNSON TEMPERATURE REGULATING CO. OF CANADA, LIMITED, (Submittor), 145 Wellington St., W., Toronto.

Automatic Switches — Pressure Operated Type.

* * *

METROPOLITAN ENGINEERING CO. OF CANADA LIMITED, 20 Hayter St., Toronto.

Enclosed Switches, Cat. Nos. 312, 313, 421-428 incl., 884-891 incl., 441-448 incl., 521-525 incl., 531-536 incl., 431-438 incl.

* * *

*BRYANT ELECTRIC CO., THE, Bridgeport, Conn.

Combination Snap Switches and Fuses.

Surface Switches "Bryant" or "Perkins".

* * *

*CUTLER-HAMMER MFG. CO., THE, Milwaukee, Wis.

"C.H." Motor Starting Rheostat and Speed Controller.

Motor-Starters and Speed Controllers.

Battery Charging and Field Rheostats.

Resistance Units.

Theatre Dimmers.

* * *

*TRICO FUSE MFG. CO., 10th St. and Cold Spring Ave., Milwaukee, Wis.

Plug Fuses "Red Seal".

* * *

Miscellaneous

THE METROPOLITAN ENGINEERING CO. OF CANADA LIMITED, 20 Hayter St., Toronto, Ont.

Cabinets and Cutout Boxes—Sheet Metal.

* * *

*These devices are under the Underwriters' Laboratories re-examination or label service.

ELECTROCUTION OF GARDEN PESTS

A very direct method of using electricity to get rid of cut-worms and other ground pests which are a nuisance to florists and gardeners in general has come to the attention of the writer.

The method is to saturate the soil fairly thoroughly with water and then apply a suitable value of voltage between adjacent points so that the current flow persuades the undesirables to turn up their toes in one last ecstatic thrill.

For lack of suitable material we have not been able to duplicate the results said to have been obtained but from experience obtained in investigating causes du mort of the genus homo we have not much doubt that the method could be made effective in the manner reported. —Contributed.

Editor Note—Mr. A. S. L. Barnes raises the question of cut-worms having toes, and also whether they would really turn them up.

THE
BULLETIN

Published by
HYDRO-ELECTRIC POWER COMMISSION
of Ontario

190 University Avenue
Toronto

Subscription Price $2.00
Per Year

CONTENTS

Vol. X1. No. 2.

FEBRUARY, 1924

THIS number of the Bulletin is given over to reporting the Convention of the Association of Municipal Electrical Utilities, which was held in Toronto on January 24th. and 25th. That the Convention was a success in every way is shown by the large increase in attendance over other conventions held at this time of the year and also by the discussions on the papers presented.

A special feature of the Convention was that of holding two meetings at the one time. During the second day the Hydro Shop managers and appliance salesmen held meetings concurrently with the technical section, when matters of especial interest to them were discussed. The attendance at the meetings of each section was very good and demonstrated the fact that the Association has become large enough to arrange its program to fill the needs of its members keeping in mind their especial capacities with the utilities, and yet have no idle moments.

J. E. B. Phelps, Sarnia, President

Opening Address

By J. E. B. Phelps, Sarnia, Vice-President

THE next order of business is the President's address. Unfortunately we have no president; we only have a vice-president, and it is my pleasure as Vice-President to welcome the delegates to this Convention. The Managers and Commissioners, Superintendents, Commercial Members and the Engineers who are members of this Association are the men who are in touch with the operations of the Hydro throughout the province. You are the men who have to deal with the public. You are the men who have to bring before the public ways and means of using electric current that is generated by and operated by the Commission. You have made a gigantic success of it, so much so that every meeting we have attended for the last couple of years Sir Adam Beck, Chairman of the Hydro Power Commission of Ontario, has repeatedly told us that by the end of 1926 there will be no more power to sell, consequently you fellows will be out of a job and you better get busy and look for one right now. In fact we do not know what we are going to do. He proposes to build steam plants throughout Canada so possibly some of the electrical engineers will have to get busy and study steam, so if you do get out of a job as electrical engineers there is going to be a job for you as steam engineers.

We are going to have some very important discussions, your executive and especially your Convention and Papers Committee have given these matters very serious consideration and I believe they have got some papers here that should be discussed very fully at this time in the history of science, papers that include some very valuable information and we hope that they will receive due consideration and as much discussion as possible. We trust that the delegates coming from the various municipalities will gather information here, rubbing shoulders with their fellow workers throughout the province, that they will gather information that will enable them to go home to their municipalities with a larger view-point and better able to serve the people at home, for after all is said and done the great service this body is giving to the people of this province is the important thing, being the service we are rendering to the different municipalities.

Recent Progress and Future Development in Electric Welding

By R. E. Smythies, Vice-President, Lincoln Electric Co. of Canada, Limited, Toronto.

IN this paper I propose to deal with the practical commercial side of welding, rather than with the scientific side, for several reasons, one of which is that I prefer to leave the latter to those who are better qualified to deal with it. During the past three years or so, many articles and papers on electric welding have appeared in the technical press and the discussions of engineering societies. This is evidence of the very great interest that is being taken in the subject on all hands. The articles and papers which I have read, however, seem to be mainly devoted to the electrical and metallurgical phenomena involved.

I am going to try and give you some idea of the progress which has actually been made to date in the practical application of electric welding to industry in general, and the very great importance of this new science to the future development of Canadian industries in particular. By "Electric Welding" I mean to include both Arc Welding and Resistance Welding, the latter being more commonly known as Spot-Welding and Butt-Welding.

The subject of the practical application of electric welding to our industries should be of peculiar interest to this Association. Ontario is the leading industrial Province of Canada and, I believe, we sometimes claim to lead the world in electrical development. It might, therefore, seem reasonable to expect that we should lead in electric welding, but it is a fact that we do not do anything of the sort. We show a rather distressing tendency to lag behind in this matter as in some others which have to do with the introduction of innovations in engineering practice. This seems to be due to the innate conservatism of many of our leading engineers, manufacturers and public officials.

Speaking broadly, the people of the United States are a long way ahead of us in electric welding and in some ways the people of Great Britain are ahead of us too, in spite of the fact that electric power is cheaper and more plentiful in Canada and we are in the habit of regarding ourselves as more enterprising than our British cousins at any rate.

There is a very great need for the whole subject to be taken up by some responsible engineering organization or body representative of both engineering organizations and government authorities, with a view to undertaking research and experimental work and the establishment of recognized standards.

Some engineers and others who want to make greater use of the process are discouraged and prevented from doing so by the resistance encountered from those in authority to

whom any sort of change from long established standards is unwelcome.

When, occasionally, this resistance is overcome we are liable to get some astonishing results. An illustration of this was found recently in Portland, Maine, in connection with the erection of a twelve storey steel building. After much hard work with architects, engineers and building authorities the contractors finally obtained permission to have the channel irons which carry the floor load, welded to the supporting beams instead of using a rivetted joint. There is very little stress on such a joint, the rivet or the weld being merely to keep the beams in place, so that it is difficult to see why there should be any objection to the use of welding for the purpose in any case.

However, the use of electric welding for this one limited application alone, saved $4,000.00 on the cost of the building, and, I understand, that the architects and engineers were very well pleased with the results.

It is easily possible to make a welded joint having 150% efficiency, that is to say a joint which is 50% stronger than the steel plates or members which are to be joined. There is, therefore, no real reason why electric welding should not be used for the more important joints in steel structures of all kinds. Enormous savings can be effected over the cost of rivetting, apart from the fact that there is an appreciable saving in the weight of steel required for a given job, where weld-joints are used.

It is safe to say, in fact, that the welded joint will eventually replace the rivet in the same way that the automobile has replaced the horse for transportation.

There is also an opening for the welder in the re-inforced concrete field. An interesting illustration of this recently occurred in connection with the building of the new bridge across the ravine to the north-west of Government House, Rosedale. It is to be known as "Governor's Bridge," and it is believed to be the first bridge in Canada, and probably on this Continent, in which welded steel members carry the entire structure and the full load of modern wheeled traffic. The

"Governor's Bridge," Rosedale, Toronto. Believed to be the first bridge in Canada in the construction of which Electric Welding plays an important part.

length of this bridge, with approaches, is about 700 feet. The span of the main arch is 200 feet.

In this case welding does not play a minor part by any means, but by availing themselves of its advantages to the full, the engineers have found it possible to design and erect a structure which is remarkable for its pleasing appearance and low cost.

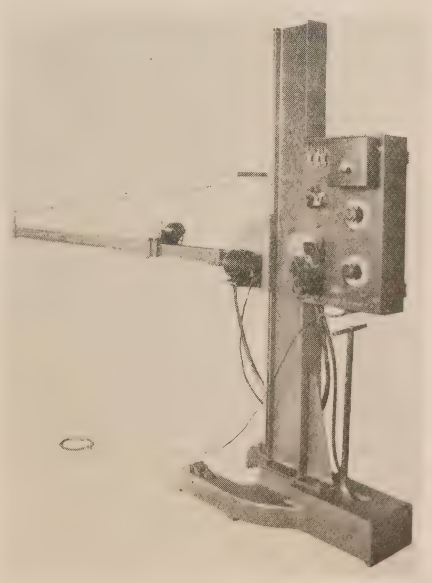
During the past five years electric welding has made some progress in Canada in the strictly industrial field, that is to say in the production of iron and steel goods in our factories. There is no doubt however, that we lag sadly behind our neighbors to the South at the present time, in spite of the advantage we have over them in the way of cheap electric power. Important developments are taking place in the United States, which are bound to have a far-reaching effect on the iron and steel industries but in which it seems very difficult to get most of our Canadian manufacturers to take even a passing interest, until they are absolutely forced to do so by the exigencies of outside competition.

One very interesting development is in the substitute of electrically welded steel parts for iron castings. Steel is, broadly speaking, less than half the price per lb. of cast iron, and owing to its superior strength we can generally save from 60 to 70% in weight by using steel.

There is a double saving here in the weight and the price per unit of weight, against which we have to offset the cost of joining two or more pieces of steel by means of the electric welding process. This process is so cheap and quick and altogether efficient that the net result is a lighter, stronger and neater job at a big saving in cost.

This idea is capable of extensive development. It is not necessarily limited to simple parts and shapes as might be at first supposed. By the aid of a little ingenuity a great many articles which have hitherto been made of cast iron can be replaced by parts made out of standard structural steel shapes welded together. Sometimes it is necessary to make use of stampings or drop forgings but these can be readily welded to other steel parts, in order to fabricate articles of more complicated pattern.

The automatic arc-welder is now a practical commercial proposition and is rapidly coming into use in the U.S.,



Automatic Arc-Welder for production work on sheetsteel goods. Welding speeds up to 240 ft. per hour have been attained with this machine.

though there is not one in Canada yet, so far as I know. By the use of this machine welding speeds as high as 240 ft. per hour on 12 and 14 gauge stock are attained. This is about 7 to 8 times the average speed of hand welding and reduces the cost per foot of seam welded accordingly.

Before leaving the field of arc-welding for the equally interesting one of resistance welding I want to make some reference to the value of the former in effecting major repairs to broken or worn-out machine parts and so saving much costly equipment from the scrap-heap. This brings us at once to the inevitable question "Can you weld cast iron?" The best answer that I can give is, "No, the blacksmith cannot forge cast iron and for the same reason it cannot, strictly speaking, be welded. While we do not claim to be able, literally, to weld cast iron, we can and do, however, play tricks on it."

I have neither the desire nor the space here to go into the scientific side of the question. In the ordinary course of business we are often called upon to try and repair large machine frames and other castings which have been broken through some accident. By experimenting along practical lines we have evolved means and methods of tackling the various jobs that come to us, and now it is very seldom indeed that we have to turn down any cast iron repair job that may come along.

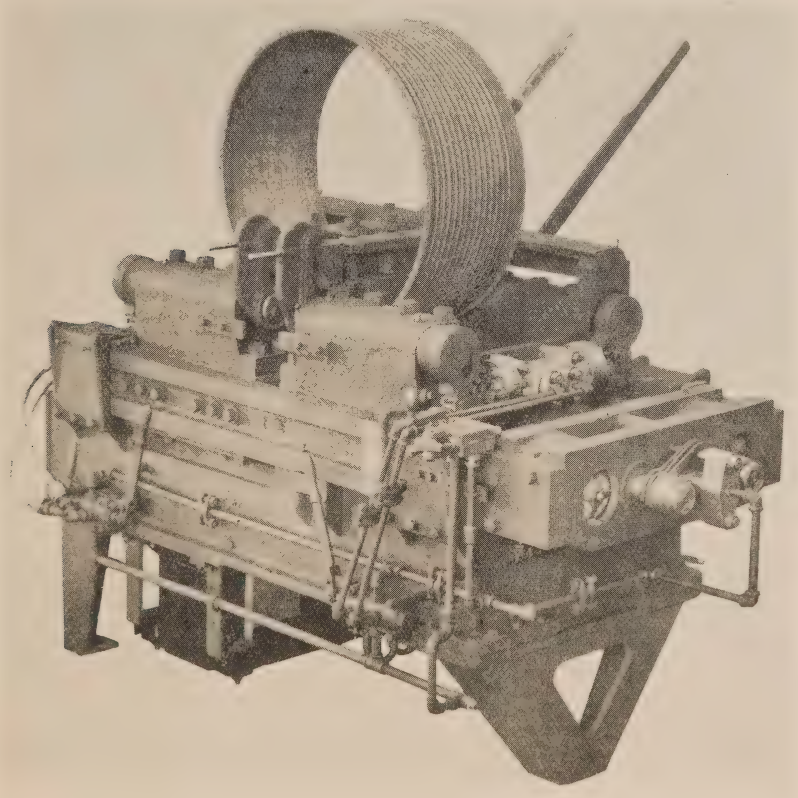
Mild steel, cast steel and bronze, brass and copper are easily welded by the arc process, and a rapidly increasing volume of salvage work on articles made of these metals is being done every year. I recently saw some very good bronze welding in the Ontario Power Co's. plant at Niagara Falls. The large turbine runners are made of bronze and the vanes are sometimes damaged by ice and stones coming through in the winter, when the screens are out. The broken vanes are made "as good as new" by means of arc welding with a special bronze electrode, and this application alone must represent a very important saving in the cost of maintaining the plant. The runners would otherwise have to be replaced with new ones, and bronze castings of this size would cost several thousand dollars.

The railroads are great users of electric welding and are getting to be more so every year. They use it for all kinds of boiler repairs, building up the worn flanges of locomotive driving wheels, welding broken engine frames, and a multitude of other purposes. It is a significant fact that many engineers and others who are strongly prejudiced against electric welding practically entrust their lives to it whenever they travel by train or boat, whether they realize it or not.

Sometimes when returning late at night from lodge-meeting you may have seen the arc-welder at work on the street car tracks at busy intersections. He will be engaged in building up the manganese steel cross-overs with a special high-manganese electrode. This is being done by many of the tramway companies now and is a real money-saver for them. I understand that there are some cross-overs in Toronto which were built up two years ago in this way and which seem to be standing up even better than the original metal.

You are probably familiar with the method of track bonding by welding fish plates or copper bonds to the tram rails with current obtained from the trolley wire, through a resistance or a special dynamotor. I will not, therefore, say any more about this now but if anyone wants to ask questions on the subject later I will do my best to answer.

Railroads are also numbered among the most advanced users of the resistance welding process. I prefer to call it resistance welding as the terms spot-welding and butt-welding tend to be misleading and confusing. Special spot-welders have been developed for making locomotive cabs, pullman car partitions, and other large sheet steel objects. A butt-welder and tube-roller combined is used for what is known as safe-ending locomotive boiler tubes. This means welding a new piece about 8 inches long on to boiler tubes, the ends of which have been destroyed by cutting out the tubes in the ordinary course of boiler cleaning and repair work. The welding operation is simple, quick and cheap, and by this means many thousands of boiler tubes are saved from the scrap heap every year.



Butt-Welder, 200 kw. capacity. Capable of handling stock up to 20 sq. in. cross-sectional area and welding same in 30 seconds.

A very interesting machine is a spot-welder which has been designed to manufacture what is known as metal lumber. This material consists of two channel shaped sections of light sheet steel fastened together by spot-welding so as to form an I beam section. It is coming into extensive use to replace lumber and heavier steel sections in building operations in the United States. The machine is power driven, automatic in operation and turns out the metal lumber at the rate of 90 ft. per minute or well over 5,000 ft. per hour.

Resistance welders are made in a wide range of sizes, to cover a tremendously wide field of application. A great many of the machines made are specially designed to handle a certain job. We cannot say that there is any definite limit as to kilowatt capacity or the size of stock handled because new records are constantly being set. Spot-welders are standardized up to a machine of 40 kw. capacity, with a throat 56 in. deep, which will weld sheet steel stock with a total thickness of ⅝ in. Special machines for heavier stock and with depth of throat up to 120 in. are in use, however.

I have an illustration of a butt-welder which has a capacity of 200 kw., will weld stock up to 20 square inches in cross-sectional area and will make such a weld in 15 seconds. It is operated by hydraulic pressure, 40 tons being used to make the weld and 20 tons for clamping the work in the jaws or dies.

One objection often raised to the use of the butt-welding process is the problem of getting rid of the "upsett" or bulge made at the point of fusion. This has been practically overcome by the simple expedient of using a higher secondary voltage, namely 7.3 volts instead of 2.5. This results in what is known as a "flash-weld", so called presumably because of the resulting pyrotechnic display. Instead of a pronounced bulge of solid metal at the weld we get a curious, spongy looking excrescence of burnt metal which is very easily knocked off while the weld is still hot. A peculiar feature of flash-welding is found in making a weld of two pieces of metal at right angles, as in the manufacture of wind-shield frames for automobiles. It is not necessary to mitre the stock. We simply take four straight pieces of the proper length, with square ends and butt-weld them at right angles so as to make a rectangular frame. When the welding operation starts the two pieces are just touching at one corner. The superfluous metal disappears in the "flash", and when the weld is completed it looks exactly as if the stock had been mitred.

There is a machine which is not really a spot-welder or a butt-welder and for want of a better term I will call it a seam-welder. It makes a continuous weld along the seam of a sheet metal article such as a milk can or coffee pot for instance, and it will readily be seen that there is a big field of application for such a machine. The speed of operation of machines of this type is about 35 feet per minute.

Some of these resistance-welders which have been developed for special applications and which do their work automatically and at such high speed, are truly wonderful.

The Power Supply Co. or Public Utility official whose business it is to

furnish them with current, however, generally regards them with mixed feelings. As a "load" they are not so good as they might be.

There is a great deal of difference of opinion as to the proper basis for computing rates for these machines. Discussion of the point might help to clear the air, and it would undoubtedly be helpful if some fair and generally accepted method of fixing power charges for them could be worked out.

I have known instances of actual refusal to allow even the smallest sized spot-welder to be connected to the line at any price. The general adoption of an unfavorable attitude towards these machines would inevitably react unfavorably on Canadian industry. Wherever the resistance-welding process finds application it is so manifestly the most efficient method to use that our manufacturers would be severely handicapped if it were not available for them.

The arc-welder of course is a straight induction motor load and therefore desirable. The more extensive use of arc-welding will help our industries to hold their own against outside competition and will be of material importance from the point of view of conservation of power. Considered as a machine tool the arc-welder performs a great deal of useful work for a minimum expenditure of power. It accomplishes quietly, without noise and fuss what can only be done otherwise by a collection of noisy, cumbersome tools such as shears, punches, air-compressors and rivetters.

Think of building steel ships, for instance, without rivets. And yet this has actually been done and will sooner or later be done more extensively. I often think that we might go a long way towards finding the answer here to the economic problem with which our Canadian shipyards are faced to-day.

I have seen cost records of experimental vessels which have been built entirely by electric welding in England. The most striking feature of these records to my mind was the high cost of power consumed with relation to labor and other items.

Why can we not at least make the attempt to see if we cannot build steel ships in Ontario by electric welding to compete in cost with British yards? Last summer there were, I believe, at one time nearly fifty ships being built in Great Britain for Canadian owners while not one was being built in Canada. The cost records which I saw were very much in favor of electric welding as against rivetting, in spite of the high cost of power.

Before anything of the sort could be done it would be necessary to make arrangements for marine insurance to be placed on the vessel or vessels when built. Surely, however, satisfactory arrangements could be made by mutual co-operation between Shipbuilders, the Government and Lloyd's or other marine insurance bodies concerned.

As I have said before, it is high time for something to be done to have electric welding officially recognized and standardized, by those who are supposed to have the interests of the country at heart.

Canadian industry is going to be severely handicapped unless this desirable result is achieved before long.

Even now it is a fact that certain

goods in the fabrication of which electric welding plays an important part and which could be very well manufactured in Canada are being imported from the United States, in spite of the fact that some of our Government Officials still withhold permission for electric welding to be used in the manufacture of the articles in question.

This is not intended as a criticism of such Officials. They are right in adopting a very conservative attitude towards any new process for manufacturing articles which come under their jurisdiction, in the absence of a recognized code of rules governing the use of such process and the testing of articles manufactured by it.

The sooner some practical steps are taken towards the establishment of a code of rules governing electric welding such as we have long had for rivetting, the better it will be for our Canadian industries at large.

If any members of this Association have any suggestions to make as to what form the initial steps should take it would be interesting to hear them, and some general discussion of the point could hardly fail to prove helpful.

Discussion

Mr. E. V. Buchanan, London: I would like to ask if there are any special electrodes used?

Mr. Smythies: Yes, all kinds of special electrodes are used and a great deal of the secret of successful arc welding is the finding of the proper electrode for the job. For a great deal of work on mild and cast steel we use an ordinary low carbon steel rod, nothing very special, the same sort of stock that rivets are made of. It is important it should be uniform as otherwise the welders are liable to spoil a lot of work before they notice it. For building up surfaces which are subject to hard wear we use either a medium carbon, about a point three carbon or point six carbon rod, and this should be flux coated as it is very hard to weld with bare. For building up with manganese rod it should also be flux coated. For cast iron I do not like to make a sweeping statement as there is a lot of difference of opinion on the subject, but in our own welding shop we have used everything we could get hold of and have done a lot of experimenting. We have found the best results from using

V. S. McIntyre, Kitchener, Vice-President

W. R. Catton, Brantford, Director

a pure armco wire with flux coating. We put on a heavy layer or bead with that and then go ahead and finish the job with an ordinary low carbon rod.

Mr. V. S. McIntyre, Kitchener: We have to import our steel street car wheels from the United States and they cost a lot of money. The steel wheel is a better wheel to operate on a railway than chilled iron, giving better traction and longer life. We find a certain wear on these wheels. We not only build up the flanges but build up the wheel, get an additional sixty thousand miles of life out of it at a cost of eighteen dollars and some cents where a new one would cost us $78.00. We also have saved a lot of money in building up manganese switch points and boxes and joints on rails. With a ten minute headway on certain sections of the track and five minutes on others, we are able to build up a joint and not interfere with the operation of the cars.

Mr. Buchanan: Can you use alternating current as well as direct.

Mr. Smythies: My own opinion is it is not a practical commercial proposition. I think one good argument for that is that none of the big companies like the General Electric, Westinghouse or the Lincoln Electric make an alternating arc welder. I know of places where they have been installed, but I do not know a single one to-day that is a practical success. My knowledge and experience is that arc welding with alternating current *is not a commercial* proposition.

I would like to get some discussion on the question of resistance welders. It is a matter that concerns you men very closely I would say and as far as I know there is no established or generally accepted method of rating them. I think it is something that should be taken up and settled and I don't know

O. H. Scott, Belleville, Director

where it could be done better than by this association.

Mr. M. J. McHenry, Walkerville: Referring to Mr. Smythies' last remarks in respect to rating resistance welders, I would say the 200 kilowatt single phase welder should have a rating of about 500 kw. connected. We had a number on our system for some time that had a capacity of about 50 kw. on four thousand volt single phase lines. When a welder came on, we knew it at the substation and generally over the whole system. It creates a very serious problem. I was going to ask if any work had been done in an attempt to get away from single phase in welders of a large capacity. The rating would be very much better if there was some method of balancing the load on a three phase system, and it would improve operating conditions very much.

Mr. Smythies: So far as I know nothing has been done in that way. I do not know whether it is practical to make a resistance welder that could be connected on a three phase line so as to balance. It seems obvious to me if it was possible it would be done.

Mr. J. R. Henderson, Sarnia: In regard to the use of A.C. current for electric welding I might say there is a machine in Sarnia in use at the present time, and giving a good deal of satisfaction. It is operated by the Holmes Foundry, who cast automobile engine blocks. This summer I had a couple of jobs done by it that saved us a good deal of money and time. They were a couple of jobs of welding spiders in railway armatures, which were done quite satisfactorily. I know of several other jobs that they have done and the work is in operation. The machine is made by a Detroit firm.

Mr. H. F. Shearer, Welland: The excess in cost of service to a resistance welder as intimated by Mr. McHenry might be applied to the investment in a three phase motor with a single phase generator and balance wheel.

Mr. Smythies: That sounds as if it would be perfectly practicable. It would increase the original investment of the man but would probably work out to show a pretty good investment on account of the saving in cost of power. When we get into larger sizes, 70 to 200 kw. it would mean a tremendous capital investment.

Mr. O. H. Scott, Belleville: I would like to ask members here who measure the load with the Lincoln Meters, how they compare with the name plate rating on the machine?

Mr. Smythies: We have a ten kilowatt spot welder in our shops also a Lincoln Demand Meter and my observation has been that one has no effect on the other.

M. J. McHenry, Walkerville, Director

Voltage Regulation on A.C. Distribution Systems

By C. E. Schwenger, Distribution Engineer, Hydro-Electric System, Toronto.

THE subject of voltage regulation on Distribution Systems is a rather large one. For the purpose of this discussion we shall consider only the alternating current system and limit this to systems where energy is distributed at less than 7,500 volts and used for purpose of supplying light, heating and power devices at voltages to the consumer of 600 volts and less. Let us also consider the distribution system as one supplied by a Transmission system such as is the case in the average municipality in the Hydro-Electric system of Ontario.

With such a system we have the following elements affecting the consumer's voltage regulation, assuming that the voltage at the generating end of the transmission system is held constant.

(1) Transmission system (including step up and step down Transformers if any)

(2) Substation transformer system between the transmission system and the distribution primary system (including step down transformers and substation feeder system, if any).

(3) Distribution primary system.

(4) Distribution Transformers.

(5) Distribution Secondary system.

Exemplifying we may have

(1) *Transmission System—*

110,000 volt transmission and at receiving end 110,000 volt transformers stepping down to 13,200 volts (let us say).

(2) *Substation Transformer System—*

Step down transformers 13,200 to 2,400 (let us say) and where substations are located at a distance from the 110,000 volt terminal substation we have the 13,200 volt feeders connecting them with the Terminal.

(3) *Distribution Primary System—*

Overhead or Underground feeders at distribution voltage (say 2,400) out of the substations and supplying distribution transformers.

(4) *Distribution Transformers—*

Supplied by the primary system and located close to consumers and delivering the voltage of supply desired by the consumer.

(5) *Distribution secondary system—*

These are the lines carrying supply voltage from distribution transformers to the consumer and include service lines.

The distribution system consists therefore of items (3), (4) and (5) above, and it is the voltage regulation on this system which we shall discuss.

It is apparent that the voltage on the

distribution system is not constant due to the drop in voltage on the transmission system and substation transformer system. The sum of these two drops is well known for any municipality and varies at each municipality depending on various factors, such as, length of transmission line, size of conductors, size of load, character of load, substation transformer regulation and loading and character of substation feeder, system, etc.

We are, however, not particularly discussing these so let us assume that voltage variation at the distribution primary lines in the substation is known.

Distribution primary lines.

Under these let us for this discussion include all that are intended to supply transformers having primary windings nominally rated at 2,400 volts.

As to choice of such lines we have in general the following:—

(1) Single phase—2 wire—2,400 volt.

(2) Three phase—3 wire—2,400 volt (delta connected).

(3) Three phase—4 wire—2,400 volt (star connected)

(4) There is also the two phase 2,400 volt line having either 3, 4, or 5 wires. This system is now more or less obsolete and will be omitted from this discussion.

Single phase, 2 wire feeders at 2,400 volts may be used where only lighting and heating appliance loads are supplied, but it is desirable to use three phase feeders in order to handle small power loads without going to the extra expense of a separate feeder operating three phase for power loads.

Let us now compare the voltage drop on the three classes of feeder (1) (2) and (3) above, using same weight of copper in each and handling a load of 500 kv.-a.—distance 5,000 feet at a power factor of 95 per cent.

Drop in Primary System

Feeder	Single Phase	3 Phase (Delta)	3 Phase (Star)
Size Conductor	No. 2/0	88724 cir. mils. (just larger than No. 1)	88724 cir. mils.
Amperes	219	126	73.1
Weight Copper (bare)	4024 lb.	4024 lb.	4024 lb.
Impedence, each wire at 25 cycles (18 in. spacing)	0.480 ohms	0.6669 ohms	0.6669 ohms
Drop at Transformer	196 volts	146 volts	49 volts
Per cent. voltage Drop	8.18	6.1	2.04

This shows that the voltage drop on 3 phase 3 wire feeder is 3 times and voltage drop on 1 phase 2 wire feeder is 4 times that of the 3 phase 4 wire feeder for the same weight of copper used. Therefore, there is a decided advantage from voltage regulation standpoint in the use of 3 phase 4 wire 2,400 volt feeder.

For the 4 wire star 2,400 volt feeder above, I have assumed that we are using the secondary neutral as a common neutral and therefore eliminating the extra weight of this conductor. It is quite evident, however, that even when the extra conductor is supplied we still show a marked advantage for the 4 wire system.

Distribution Transformers

These have a regulation, for loads at 95 per cent. power factor of about 2.4 per cent. on full load, on an average; that is, the voltage rise from full load to no load would be 2.4 per cent.

Transformers on short heavy loadings, such as is common in lighting and heating (ranges) can safely operate at 50 per cent. overload and under these conditions the regulation would be 3.6 per cent. (approx;)

Secondary Distribution System

Here also we have the choice of several systems.

(1) 2 wire, 120 volt, single phase,

(2) Polyphase, 120 volts (4 wire).

(3) 3 wire, 120 volt, single phase.

Let us now compare these systems for voltage drop using same weight of copper in each and handling load of 12,000 watts, 500 feet, starting with 2 wire system, having No. 2 conductors, and for easy calculation, 100 per cent. power factor.

Drop in Secondary System

	2 Wire, 1 Phase 120 volt	3 Wire, 3 Phase 120 volt	4 Wire, 3 Phase 120 volt	3 Wire, 1 Phase (Neutral ½ outer) 120/240 volt
Size Conductor	No. 2	No. 4	Approx. No. 4½	No. 3
Amperes	100	57.7	33.3	50
Weight Copper (bare)	200.6 lb.	200.6 lb.	200.6 lb.	200.6 lb.
Impedence, each wire at 25 cycles (18 in. spacing)	0.08 ohms	0.125 ohms	0.14 ohms	0.1 ohms
Drop at 120 volts	16.1 volts	12.5 volts	4.62 volts	5 volts
Per cent. Drop at 120 volts	13.4	10.4	3.85	4.17

From the above there is shown a slight advantage for the 4 wire 3 phase, 120 volt secondary line. With this system we have, however, greater difficulty over the 3 wire single phase system in the matter of maintaining balanced loading conditions. The transformer arrangements to supply such a system are more complicated. The 3 wire single phase system has the advantage also that standard 220 volt devices may be supplied from it.

The 3 wire system single phase has, therefore, decided advantages in its favor and should be used.

It is obvious that the 3 wire single phase 120/240 volt service is also the best to use for the supply of house lighting and heating (ranges) loads.

These should not give a voltage drop of more than 2 per cent. on an average.

overcome by use of voltage regulators.

Feeder Voltage Regulators.

These regulators are usually of the induction type and we will consider only these.

They may be either automatic in their operation or of the hand control type.

If of the automatic type suitable compensators control the regulating gear and give constant voltage at points on the line for which the compensator is adjusted.

If of the hand control type, which is cheaper (approximately 10 per cent. less than full automatic) each feeder would be equipped with voltmeters reading the voltage on the compensator which would be adjusted to indicate conditions at the point on the feeder

TOTAL DROP IN DISTRIBUTION SYSTEM FOR CASES ASSUMED ABOVE

Feeder	2400 volt single phase.	2400 volt 3 phase,3 wire.	2400 volt 3 phase, 4 wire.
Primary Feeder Drop, per cent.	8.18	6.1	2.04
Transformer Drop, per cent.	3.6	3.6	3.6
Secondary Drop, per cent.	4.17	4.17	4.17
Service Drop, per cent.	2	2	2
	17.95	15.87	11.81

The 3 phase 4 wire feeder, therefore, gives the best inherent voltage regulation by virtue of its smaller voltage drop.

This voltage drop may be largely

where constant voltage is desired. The substation attendant would then constantly adjust the regulator so that the voltage showing on feeder voltmeter as compensated, would be constant.

This is a fairly satisfactory arrangement and costs less than full automatic. It has, however, the limitation that momentary voltage variations on the distribution bus are not properly taken care of on account of attendant possibly not being on his rounds at the time.

Full automatic control eliminates this human factor and produces best results. Surges in voltage are quickly taken care of.

In regulating the voltage on a primary feeder it is clear that where the load is distributed along this feeder that constant voltage cannot be maintained at all points along this feeder at the same time on account of the voltage drop being different at different points along this feeder when loaded.

If, say, we maintain constant voltage at the distribution transformer secondary on a transformer nearest the source on a feeder we then have a voltage drop at the transformer secondaries for transformers at the remote end of the feeder equal to the drop in the primary feeder.

On the other hand if we compensate for all this line drop so that constant voltage results on transformer secondary at remote end of feeder it is clear that there will be a rise in voltage equal to the primary feeder drop at transformer secondaries nearest the source.

We must, therefore, select a mean and arrange for constant voltage at a point along the feeder such that the drop in voltage at most remote transformer will equal the rise in voltage on the transformer nearest to the source.

For a single feeder having evenly distributed load this point is 1/3 the distance out from the source assuming the feeder to have a distributed load throughout its whole length.

Let us call such a feeder a "Straight away" feeder or "Single" feeder.

It is evident, therefore, that on such a feeder we cannot obtain constant voltage on all transformer secondaries and that the worst regulated transformer secondaries have a variation in voltage of ½ the primary feeder voltage drop which the regulator cannot overcome.

Where regulators are used we have also the "feeder and main" system of primary distribution as against the single feeder.

In the single feeder loads are taken off all along the line whereas in the feeder and main arrangement the feeder is run to a centre of distribution near the centre of the load and mains are run in various directions from this centre. No loads are tapped off the feeder between substation and the centre of distribution but all are taken off the mains.

Let us consider, therefore, that a feeder delivers to a centre of distribution which, in turn, supplies only two mains. These mains then each carry only ½ the load of the corresponding single feeder and are only ½ the length of the supplying portions of the single feeder.

If now we regulated for a point 1/3 out from the source which in this case is the centre of distribution, we get a variation in voltage as between nearest and furthest out transformer secondary of only ¼ that of the single feed-

er. We are, therefore, able to make the voltage variation between most extremely located transformers much smaller.

If, however, more than two mains are supplied from the same centre of distribution and these handle the same load as the single feeder a further reduction in voltage variation between transformers is accomplished.

If four mains are used we get 1/4 the load and 1/4 the distance or only 1/16 the variation on the corresponding single feeder.

This of course pertains to ideal conditions. The single feeder often has branches which brings it closer to the "centre of distribution" type. Sometimes the mains leading from the centre of distribution do not balance each other in size of load and length but even so, much better results are obtained than with the corresponding single feeder.

Now what is to be gained by close voltage regulation.

In regard to lighting let us examine the effect of voltage variation on the cost of lighting. The following is well known:—

would get if normal voltage was supplied.

For cooking devices the same thing holds. For instance on a range it has been found that 10 per cent. decrease from normal voltage makes it necessary to heat any given oven for a 40 per cent. longer period than with normal voltage to get the same temperature. This will be at an increased cost to the consumer of nearly 20 per cent. The effect of low voltage on split phase motors is similar, with additional danger of expense to consumer in motor burn outs, etc.

Therefore to be fair to the consumer whom we are serving we should supply him with what he pays for, at the lowest cost consistent with the service given.

It is obvious that the giving of good voltage regulation actually gives the consumer something which he does not get where regulation is poor. This he gets either in the form of a smaller power bill or as more light. Against this is the cost of obtaining such good service for the consumer and it is also obvious that the cost to supply regulated service is higher than to neglect

Voltage, per cent. of normal,	105	100	95	90
Power used, per cent. of normal	108	100	92	85
Light given, per cent. of normal	118	100	84	69
Per cent. of normal cost to get normal candle power	91	100	112	125
Life, per cent. of normal	50	100	200	280

From this it is seen that the ultimate consumer is penalized by low voltage either by not getting the light for which he pays or by paying at a higher rate for the light he desires or obtaining good regulation. The thing therefore operates against the supply system since its revenue is cut and its costs are raised. After all though, the consumer who is being served receives

the full benefit and that is as it should be. The whole matter resolves itself into how much we are willing to increase our operating costs or we might say to reduce our surpluses if any in order to properly serve our consumers.

Now let us consider the voltage variation due to the transmission system and the sub-station transformer system as mentioned above.

Let us take a typical case such as would exist on one of our Toronto sub-stations where the variation on 2,400 volt bus is normally about 7 per cent. or 8 per cent., let us say 8 per cent. This means that voltage on peak load ordinarily is 8 per cent. lower than it is off peak. If normal or average voltage is 2,400 on this bus then it will vary from 2,300 approx. on peak to 2,500 volts off peak. Thus if regulated so that normal voltage can be maintained at all times a 4 per cent. regulator will suffice that is it can boost 4 per cent. on peak and buck 4 per cent. off peak and maintain constant bus voltage.

By the use of synchronous condensers we are able to reduce this bus voltage variation to less than 50 per cent. of the bus voltage variation when not controlled by synchronous condenser.

In this way only 2 per cent. regulators at most are required to maintain constant bus voltage due to transmission and sub-station system voltage variation. Add to this variation of bus voltage the distribution system drop, which was mentioned above, and which on our feeders totals on an average feeder about 10 per cent. we then have a total variation where condensers are used of 10 per cent. plus 4 per cent. or 14 per cent. which would warrant the use of 7½ per cent. regulators on the primary feeders.

However, in stations where no automatic synchronous condenser bus voltage regulator is used, we must provide regulators capable of handling voltage varation of 10 per cent. plus 8 per cent. or 18 per cent. In these stations we must use 10 per cent. regulators on the primary feeders.

Let us distribute from a bus without using feeder voltage regulators and we then have a bus voltage change of 8 per cent. and a distribution system drop of 10 per cent. at remote end, a change of voltage at transformer furthest from station of 18 per cent. If primary feeder drop is 3 per cent., then we have for transformer secondary nearest source a variation from no load to full load of 15 per cent.

Let us use voltage taps on transformers so that 10 per cent. above normal voltage exists on remotest transformer and 5 per cent. above normal voltage on nearest transformer.

	Nearest	Furthest
No load	105% normal	110% normal
Full load	90% normal	92% normal

Thus by use of taps we obtain as maximum drop in voltage 10 per cent. below normal voltage instead of 15 per cent. or 18 per cent. below normal voltage when feeder is loaded and giving most service. During light loads, however, we are supplying higher than normal voltage but this affects relatively few devices as load is light. However, any lamps used have a very short life under these high voltages.

Where regulators are used a maximum voltage variation as between

various parts of the system will not exceed 1½ per cent. if mains have only 3 per cent. drop.

Cost of Feeder Voltage Regulation.

For 3 phase, 2,400 volt star feeder 10 per cent. voltage regulators cost installed approximately $9,414.00 for 1,750 kv-a. feeder or $5.00 per kv-a. regulated. This at say 15 per cent. for interest, depreciation and sinking fund gives the annual charge of 75¢ per kv-a. regulated. These regulators have a loss on peak of 5 per cent. of 180 kv-a. or 9 kw. this equals with cost of power $32.00 per kw.—$288.00, or nearly 18¢ per kv-a. regulated.

We, therefore, incur an expense of over 93¢ per kv-a. regulated and this may be looked upon as an increased cost of power or as an addition of this amount to the system's power bill for which the system gets less revenue but for which the consumer gets better service.

Let us say it costs $1.00 per annum per kv-a. to regulate.

It is obvious that where synchronous boosters are used and regulators of only ½ capacity are required that it costs only 50¢ per annum per kv-a. to regulate.

Cost to regulate same amount, as compared with 3 phase 2,400 star.

Feeder (2,400volt.)	Regulator	per cent.
3 phase, Star	3-1 phase	100
3 phase, Delta	2-1 phase	140
3 phase, Delta	1-3 phase	122
1 phase	1-1 phase	120

From this it is shown that the 3 phase 2,400 volt Star feeder has an additional advantage over all others in costing less to regulate.

As the purpose of our meetings is to bring out discussion so that we may all learn, I have collected the above notes as a basis from which to start such discussion. Some points are merely mentioned. Due, however, to lack of available time these are not amplified.

Discussion

Mr. H. O. Fisk, Peterboro: I would like to ask Mr. Schwenger what he would do if some of these feeders became suddenly overloaded.

Mr. Schwenger: In the case of a feeder voltage regulator becoming overloaded, one thing that we do is to buck it to reduce the load. If it becomes very serious we throw the feeder over to the emergency bus and cut out the regulator altogether. It is done very quickly.

Mr. H. F. Shearer, Welland: This paper has been extremely interesting. The difficulty that I see is in applying the conditions of the large distribution system to the smaller system. In the past it has been considered good construction to use a ring bus in the smaller municipalities. The question came to me in reading over this paper, how you would handle voltage regulation on the ring bus and at the same time be prepared for the necessity of having to close or limit point distance. Supposing you chose an intermediate point on both sides of your ring bus, you would have one set of regulators

overloaded and the other underloaded to the same extent. I would like to ask Mr. Schwenger just how he would advise locating the regulators in order to overcome that difficulty.

Mr. Schwenger: You mean if you are operating a ring bus with a regulator at each end of the ring?

Mr. Shearer: With regulator controlling each section.

Mr. Schwenger: That would be two single feeders then.

Mr. Shearer: The point is, how would you handle in case you had to close or limit point distance.

Mr. Schwenger: That is just the same thing this gentleman asked. We cut the regulators out and throw them over. Does that answer your question?

Mr. Shearer: You eliminate your regulators entirely?

Mr. Schwenger: Oh, yes, you cannot operate them together very well.

Mr. Fisk: It would be good business to procure the regulators somewhat larger than immediate demands, perhaps, would require.

Mr. Schwenger: Well, our practice is to get the regulators for the capacity of the feeder, and when the feeder exceeds the capacity, why, it means putting in another feeder, and, in that case, you get the reserve capacity on the new feeder. I don't recommend putting in regulators too big, that is, bigger than the capacity of the feeder.

Mr. E. R. Lawler, H.E.P.C. of Ont.: Is it practical to supply a small amount of lighting on power feeder and try to regulate just that one phase, with a single phase regulator?

Mr. Schwenger: Yes, that is very practical. I might have brought that out in the paper, but in the case of a three-phase star feeder you can get almost perfect regulation on one phase by putting the regulator on that phase and leaving out the two other regulators for power purposes. That is very often done, in fact it is standard practice in some of the systems on the other side.

Mr. Lawler: Would you favor single phase regulation instead of three-phase regulation?

Mr. Schwenger: Yes, I am in favor of single-phase regulation.

Mr. H. D. Rothwell, H.E.P.C. of Ont.: I would like to ask Mr. Schwenger what he has observed in the way of secondary distribution regulation. I put a recording volt meter on the alternate sides of the 220 volt system, and in turning on one of the burners of the range got a decided rise in voltage on the other side, as much as 5 to 7 volts. Normally we can get 120 volts, and by putting on this load on one side of the neutral, the voltage on the other side went up to 127, which appears to me to be quite a considerable rise. I think that is something that is bothering the householder situated on the end of long secondary lines.

Mr. Schwenger: You are referring to conditions in Toronto.

I might say, as a word of explanation, that the Toronto secondary network was designed for a load of 600 watts per 100 feet in the early days. That, of course, is not ample at all, and has not been for some years, and our biggest job at the present time is to bring that copper up to carry a much greater load. The chances are that you are on a section of the old secondary system.

Mr. Rothwell: Constructed since 1914.

Mr. Schwenger: Well, even then we were still standardized on the smaller secondaries. It is quite apparent that the voltage rise is due to the current in the neutral; on the rebuilt secondaries we put in a heavy neutral and get very close regulation.

Mr. Rothwell: Do you recommend having a neutral?

Mr. Schwenger: As a service proposition, yes. We usually make it two sizes smaller than the outside in the feeder, the service wires being of the same size.

Mr. D. E. Charters, Windsor: Mr. Schwenger showed a typical feeder in a station. I wish he would explain it. As I understood it, there were three feeder wires coming out which went to about the centre of load, and there three three-phase feeders branched off.

Mr. Schwenger: The whole diagram was three-phase.

Mr. Charters: Well, if there were single-phase branching from each one I could understand that where the principal heavy wire ended and the branch feeder of single-phase went in each direction, a bank of three single-phase regulators would be probably more serviceable. But where the three phases go in each direction the question arises which is the better, single or three-phase regulators. Where the branches are three-phase and a transformer breaks down when you are changing the transformer without interrupting service and try to parallel getting on the wrong phase, necessarily you cannot parallel. I bring that out as a distinction between single and three-phase

Mr. Schwenger: That point is well taken. We are operating the former Toronto Electric Lighting system which is laid out with three phases to the centre of distribution, and each branch coming up from that centre is a single-phase proposition. We are changing that all over to three-phase at the present time. About the apparent difficulty of the linemen connecting up another transformer parallel with the existing transformers, there should be no difficulty. You can see plainly which wire the existing transformer is connected to. Our wires are all three-phase and the loads on them are balanced and everything is banked. We have standardized on four banks, in general. I do not quite get the point about the single or three-phase regulators.

Mr. Charters: Well, if the branch feeder is single-phase coming from the main in the district then a single-phase regulator could regulate for a distance out and you would get better regulation than if you had a three-phase at the station regulating for the whole district.

Mr. Schwenger: That is exactly what I said, the single-phase regulator does do that; the three-phase regulator isn't so flexible.

Mr. J. W. Peart, London: I am sure that the Association is very fortunate in having a man of Mr. Schwenger's experience here to address us this morning, and I feel that all those in a similar position to myself who are dealing with similar problems on a smaller basis have listened carefully to what he has said. Mr. Schwenger has pointed out that in Toronto he has some stations where he has regu-

lation on his bus bar by means of synchronous condensers, thereby enabling him to use regulators of approximately half the capacity than he would have to use had he not that synchronous regulation. It would be interesting to know just what conditions would obtain in case of a shut down in his synchronous equipment.

Mr. Schwenger: Under those circumstances we would have to be content with poorer voltage regulation. Supposing your regulators were operating at full boost normally with the synchronous condensers, and if the synchronous condensers ceased correcting the feed voltage your voltage would drop slightly, and you might have to be content with a 5 per cent boost instead of a 10 per cent, which is better than no boost at all. That is only a temporary condition, something we haven't had to deal with yet.

Mr. Rothwell: I would like to ask Mr. Schwenger how much increased revenue he would get from a circuit that was regulated over and above one which was not regulated. He mentioned that it cost something like one dollar a kilowatt to regulate, and there is no doubt that the revenue from the consumers would be higher under those circumstances.

Mr. Schwenger: The point I wished to make in the paper was that you do not get any additional revenue through regulating. I doubt if you get any additional revenue over and above what you get if you were not regulating.

Mr. Rothwell: For instance a range or lights will consume more?

Mr. Schwenger: Well, on low voltage a range has to be operated 40 per cent. longer, and if you have proper voltage the cooking is done in much shorter time; the revenue is less, that is a proven fact. In lighting it is a little different. You may or may not get it as a revenue. We will say that you had a definite power of lamps installed. There was a lower voltage all the time not giving enough light. The consumer then put in bigger lamps to get the light. As soon as you start to regulate you increase the bill, but if the consumer had not changed the lamps you would not increase the bill at all by regulating. It is only where the consumer by putting in bigger lamps, which is commonly done, that it increases the bill. The chances are that as the lamps become burned out he would put smaller ones in again and I doubt if you would gain much in revenue. The plant has spent a lot of money in getting good regulation. You do not get revenue anything like what you pay for it.

Mr. Peart: I have another question I would like to ask Mr. Schwenger regarding regulating bus voltage by synchronous condensers. He points out that the variation can be reduced about 50 per cent. Is this limitation due to the size of the equipment, or is it proven by operating conditions that 50 percent. is about the best you can do? Wouldn't it be possible to get this up to 75 or 80 percent.?

Mr. Schwenger: That depends entirely on the bus operation. It is quite obvious if you have an operation or rather variation very high, say 25 percent., you couldn't bring that up with synchronous condensers, but where you have normal variations like we have, 8 percent. you can correct most of that.

In fact, at one of our stations we get a variation which is very slight, I put it down as 2 percent. station voltage on the bus due to the condenser alone. The condenser is primarily put in for power factor correction. The voltage regulation you get is incidental.

Mr. G. F. Drewry, H.E.P.C. of Ont.: I would like to ask Mr. Schwenger if the Toronto system has tried out any static condensers to see if they are successful in power factor correction.

Mr. Schwenger: No, we have not tried out the static condenser. It is only within recent times that the 25 cycle static condenser has been used as a commercial proposition. I do not know of any installations of the 25 cycle static condenser. I think the Eugene Phillips Company in Brockville have one, on 60 cycles, and, I believe, it is very successful.

Mr. Drewry: I know about it and that is why I asked Mr. Schwenger. They have a 200 kv.-a. condenser down there which has been in service ever since installation and has required no attention. Their load is approximately 800 horsepower. Its installation is simple, requiring an oil switch and a nominal amount of room and looks to be a very good proposition. I believe the cost was not extreme.

Mr. C. C. Elvridge, Durham: In a small town such as ours, would you consider it good business for us to install a power factor regulator. The load on our plant is 350 horsepower with a power factor sometimes as low as 73 percent. Very seldom during the summertime do we have power factor higher than 86 percent. Could you give us some advice as to installing a regulator for a sub-station of that size that would be of benefit to us,

Mr. Schwenger: As I see it, it is a matter of dollars and cents. If your power factor is as low as you say, below 75 percent., I would say offhand it would be the proper thing to do to correct it. We find that where our power factor drops below 90 percent. the penalty is approximately half the cost of power, that is the reactive end of it. With our power cost at $24.00 per h.p., we can, with the synchronous condensers, cut out the penalty at a cost of $3.50 and save the difference. It is a very small cost compared with the penalty to cut it out, that is, with our larger units. I believe the same thing would apply with the smaller unit but the difference would not be so much.

Mr. Elvridge: The cost per horsepower is $40.

Mr. Schwenger: I would say offhand it would pay to do it.

Mr. Lawler: I would like to ask Mr. Schwenger whether he finds it pays to regulate a multiple street lighting system, and also another question comes up about the capacity that these lighting feeders should be. For example, in Windsor we find feeders of 6,000 kw. capacity would be better than 2,000 kw. and put in less feeders. It seems that, in small cities, the load per thousand feet of street would be about the same as it would be in Toronto, and, if that is the case, I should think it would be economical to put in the same size or same capacity of feeders.

Mr. Schwenger: In regard to the regulation for multiple street lighting, we have found that that was particularly advantageous especially where the lighting is on all night and the voltage after midnight is usually high. We at

one time bucked the voltage approximately 15 percent. after midnight and obtained almost double life on the lamps. At the present time we arrange to regulate the street lighting feeders with automatic regulators, and operate them so that they will be bucked after midnight. The synchronous condenser is also bucked at midnight, giving about 5 percent. buck on the street lighting feeders, all of which give considerable increase in the life of the lamps. We have about ten feeders now operating at 500 amperes 4,000 volts; that is a capacity of 3,500 kv.-a. A factor that permitted us to go to the 3,500 kv.-a. feeder was the fact that we could reconnect our 10 percent. and 5 percent. regulators and operate them on the increased feeder, working out very well. Our standard feeder before that was 250 amperes 4,000 volts. We are using the 250 amp. feeder where it supplies districts well out from the station where greater than 5 percent. regulation is required. We standardize on 250 and 500 ampere feeders.

Mr. Charters: In regard to the large sized feeder, where a town has not got a condenser you cannot use a 4 or 5 percent. regulator. If the incoming line voltage is above normal, 2,500, and, for some reason or other the regulator goes bad and it starts to boost; there will be a district where the voltage is exceedingly high until that regulator is cut out of service for repairs. Where you are only using a 4 percent. regulated bus it isn't so serious, but it takes money to put in a large condenser to bring down that first 4 percent.

Mr. Schwenger: In that case you would use a regulator with greater capacity, that is, instead of using 5 percent. you would use 10, or whatever it may be, and if the regulator goes bad it should be immediately apparent to the operator in charge, and he should cut it out.

Mr. J. H. Caster, H.E.P.C. of Ont.: There was the question brought up of putting in synchronous condensers to correct power factor. I think it is too big a problem to be answered offhand. One should get busy and figure on it, and I would suggest that the gentleman get busy and figure on it himself. Putting in a $50,000 synchronous condenser to bring your power factor up, using probably 100 kilowatts, isn't entirely good business in a lot of cases. It is much better probably for that man to investigate and see whether his motors are loaded. If they have poor power factor they should be thrown out probably, and new ones put in, but I am not prepared to state just what should be done. We have had wonderful results all over the Niagara District without synchronous condensers; the majority of towns recognizing that they can afford to get better designed transformers. It isn't fair to our customers to allow them to go ahead putting in equipment that does not meet their requirements. We have few men in the Province who are capable, or who make a business of giving intelligent and honest advice to the man who wants to put in new equipment. There should be more attention given to the customers on 60 cycle districts in regard to the motors they should purchase. It isn't so bad in 25 cycle districts, because the motors are better in regard to power factor. It requires more intelligent thought on the matter.

In Mr. Schwenger's paper he did not

say what the cost was of regulating by a synchronous motor, he kind of glossed that over. In the last paragraph he says the cost of regulating can be cut considerably by the use of synchronous condensers. I don't know whether it can or not. I do not think, gentlemen, you will gain very much on this power factor question, regulating by means of synchronous condensers. It is the old story of adding an insult to correct an injury.

Mr. Schwenger: I said before that the synchronous condenser was put in primarily to correct the power factor, and to tack the whole cost of the synchronous condenser on to voltage regulation isn't right. It isn't put there for that purpose. I thoroughly agree with Mr. Caster in his statement that the character of the load should be investigated and underloaded motors brought up to their proper load.

Mr. T. R. C. Flint, Toronto: We are trying our best in Toronto to bring up the power factor of our different consumers. We have made a great many tests in various factories, and we have gone into the various sizes of motors installed in various factories. Wherever we find motors of poor power factor we immediately bring it to the consumer's notice. The consequence is that we have increased the power factor of the system as far as the power load is concerned, considerably.

The point was brought up a few minutes ago with regard to static condensers. We have gone carefully into that, and have found that the cost of the static condenser, 25-cycle, to a consumer is prohibitive, and in a good many cases the size of the motors have been changed in place of putting in static condensers.

Mr. Schwenger: With regard to the exciting current of transformers, we have standardized on 2,400 volt transformers for some years now. We have transformers that have an exciting current of less than 2 percent.; were they over-excited it would run up well over 10 percent. That is another factor that affects the system power factor.

The Merchandising Section

Proceedings of Meetings

Chairman—Mr. G. J. Mickler

The Chairman: Gentlemen, For this meeting this morning we have not outlined any definite programme. The idea of holding this meeting is the combination of the ideas of two or three of the Shop men and myself to allow for the discussion of things which concern merchandising men in the various municipalities and to give these merchandising men perhaps a little better opportunity than they have had in the past for mutual discussion.

I thought I would outline in a general way what has been done up to the present time by the Merchandising Committees of the A.M.E.U. and of the Hydro Commission. As the most of you are aware there is a general Merchandising Committee in existence which has deliberated on several occasions on recommendations made by sub-committees of this Committee, and at the Orillia Convention reports of the various Committees were submitted and notice was given at that time that these various reports would be consolidated into pamphlet form for distribution to the various Hydro municipalities as a guidance for the men actively engaged in merchandising, on how to conduct their affairs and what principles are underlying the merchandising of appliances in Hydro shops. I have consolidated the various reports, and while I had hoped to be able to submit the consolidated report to a meeting of the Merchandising Committee it was not possible to do so because I could not get the Merchandising Committee together in time. I have in addition to outlining the general plan of operating a Hydro Shop a very interesting item on the programme this morning on the installation of ranges. I have gathered a lot of information since the meeting in Orillia on the cost of installation in the various municipalities in the Province, and in comparing these costs a great many inconsistencies appear which it might be well for the various members to know about.

I have also had brought up here a high pressure range installer who is going to tell us of his methods of installing ranges cheaply. You will probably remember at the Orillia Convention there was quite a discussion, and in fact there was great criticism regarding the low cost at which some ranges were being installed, and it is to show the doubtful what can be done that this man is here to-day.

I will read in brief the consolidated report as I have prepared it. It is intended as I said to print this report in pamphlet form for general distribution, and included in that pamphlet will be a general outline and full description of the Hydro Shop accounting system which I have prepared, a full description and instructions on how to operate an accounting system in a Hydro Shop as well as certain suggestions on merchandising which I have selected from the publications of the Society for Electric Development.

THIS PAMPHLET IS ISSUED BY

1. To increase the number of Hydro Shops throughout the Province.
2. To justify in the minds of the doubtful, the establishment of Hydro Shops.
3. To establish uniformity of policy, price and general operating practice among all Hydro Shops.
4. To stimulate the sale of electrical appliances generally to increase the use of Hydro power.
5. To promote a better feeling of co-operation between private electrical dealers and the Hydro Shop.
6. To standardize the practice of servicing appliances.
7. To establish a uniform system of accounting to permit of an intelligent study of operating conditions in each Shop, comparisons of the results of one Shop with another, and to safeguard the interests of the Hydro customers, by preventing, if possible, the operation of a Shop at a monetary loss.

THE HYDRO SHOP.

1. The reason for its existence.
2. Functions.
3. The policy which should govern in a general way the operation of a Hydro Shop.
4. Advertising and Educational propaganda to stimulate the use of Electrical Energy in the home and factory, by the use of Electrical Appliances.
5. Servicing Electrical Appliances.
6. Proper Accounting System for operation of Shop, along strictly business lines.
   Collections—Time Payment, etc.

SHOULD MUNICIPALITIES ENGAGE IN THE MERCHANDISING OF ELECTRICAL APPLIANCES? OPERATE A HYDRO SHOP?

This question has been debated in season and out of season ever since the Hydro was established, and in fact a similar question has confronted privately-owned central station bodies since such things have existed, and so long as men are free to argue, the question of the justification of a central station entering into competition with electrical dealers and contractors will be a live issue.

Needless to say some institution must exist, some body with stability, financial strength and probable long existence, to stimulate the sale of electric current in its many uses by promoting the use of electrical devices of all kinds; to sell these devices to consumers of electrical distributing stations, and to keep these devices in constant operation condition. These are the requirements necessary to build up in the minds of the general public a lasting confidence in things electrical, and to insure the most rapid development of the electrical device field.

Central station bodies, both privately and publicly owned have long since realized that leaving the entire development of the appliance field to private electrical dealers or contractors resulted in a very slow development of load from this source, and in many instances the establishment of load conditions not at all desirable because they had no control over the size and type of appliance being connected to the various parts of their systems, and dissatisfied customers because appliances would not be properly sold or demonstrated, so that when large bills for current appear, the central station is held responsible for poor and expensive service.

Many stations have undertaken to stimulate their business by maintaining elaborate showrooms to display the many devices by which life can be made worthwhile through the use of electric current in the home and elsewhere, but when customers discover that the things on display are not for sale, their interest lags and the showrooms prove more or less of a failure.

The Hydro Municipalities are in the electrical distributing business, a business which requires a lot of advertising and education to bring the consumers to the point where they will derive the utmost benefit from the use of electricity, and to distribute and sell every kilowatt hour possible to make the operation of each system a complete success financially. Unlike almost any other line of business the thing to be sold—kilowatt hours—are invisible, and the only way to dispose of them is to dispose of the means to utilize electric current—electrical appliances, and to lead the way for others to follow in each community in a well defined plan of load development.

It is hardly necessary to say that private electrical dealers should not enter the field in competition with a Hydro Shop. Private dealers fill a most important place in every community of any size, and few Hydro towns can dispose with them entirely; the more depots there are for the disposal of good electrical appliances, the quicker will be the realization of our hopes of a satisfactory load condition, electrically and financially. But the Hydro should

lead the way, set a high standard example for others to emulate and watch things boom.

It is a well-known fact that, with few exceptions, where central stations do not merchandise the electrical appliance business is dead for all, but let the station start a Shop and things begin to hum for everybody in the electrical business almost at once.

As an example of this it may be well to quote the case of a mid-western city of over 250,000 population. Up to a few years ago the policy was to sell energy and lamps only. "Leave it to the dealer" was its motto, so far as appliances were concerned. Did the dealers appreciate the situation? Did they get busy and make the most of their opportunity? Did they advertise on billboards or in the newspapers—conduct demonstrations—circularize the station consumers? Did they ever analyze the appliance load of the town? They did not, and they wondered why their appliance business was dead. The central station in question finally came to a realization of this condition. It decided to get busy and to become an active merchandiser and it believed in "doing the job up brown". A location was secured in the heart of the shopping district. No expense was spared in fitting out the display room as the outstanding appliance showplace of the city. Neither was any money spared in widely advertising that fact. A tremendous howl went up from the dealers. Appliance business was going to be ruined! The central station would wreck the whole merchandising works. It would kill what little had been accomplished.

What actually happened? The town just began to wake up to the value of the appliances. Nobody had ever taken the trouble to tell it the real story before. The central station used billboards, newspapers, sales letters, attractive windows and freely advertised the appliance Shop. The public's interest was aroused. People were soon thoroughly "sold" on the electrical household idea. Appliance sales increased by leaps and bounds. Dealers who had bitterly fought the movement sold more appliances than they ever dreamed was possible. Department stores opened special electrical departments. Electrical specialty shops with high-grade equipment and merchandise sprang into being. Hardware stores got busy. Everybody was benefited. Even the dealers admitted that. Had the central-station company not changed from a passive to an aggressive merchandising policy, that city to-day would still be plodding along in the same old way.

There are many Municipalities in Ontario, to which one could point, where the appliance business is dead and electrical dealers are just as dead as the business. What they need is the waking up which only a properly organized Hydro Shop can give them.

The Functions Of A Hydro Shop.

In every community where Electric Power is sold, and where economically practicable, a Hydro Shop should be opened up.

1. To promote the use of electric current by the sale of electrical appliances.
2. To foster a spirit of co-operation with electrical dealers in town to encourage them to promote Hydro interests as well as their own.
3. To uphold the standard of electrical appliances used on Hydro lines by encouraging the sale of only the best.
4. To maintain in service all electrical appliances on consumers' premises to insure maximum current consumption.
5. To develop the proper kind of load by encouraging the sale of certain appliances, and discouraging the sale of others.
6. To educate consumers in the proper way to operate appliances to insure complete satisfaction to them and to keep their bills within bounds.

The Policy Which Should Govern a Hydro Shop.

In operating an Electrical Shop of high standard, there are certain fundamental principles which should govern the policy of such a Shop. Otherwise it will fail in the purpose for which Hydro Shops are established, and the following general rules might well be adopted wherever a Shop is in operation, or about to be opened up.

1. The decision to open a Hydro Shop should be based on the principle that what is worth doing at all is worth doing right. This involves the necessity of employment where necessary of a competent manager, one who is familiar with electrical merchandise and merchandising in all its branches; of engaging competent clerks, service men and others who may be necessary to carry on the work of an up-to-date electric shop; of a determination to know that the business is being properly conducted and is paying its way by the installation of proper

accounting systems, accompanied by a determination to see that such accounting system is properly operated; of a realization of the advisability of treating the Hydro Shop as though it were the private business of a Hydro Commissioner, which would of necessity have to be made to pay, have to do business in a strict business way, have to enter fairly in competition with similar businesses in town, and be a credit to the community itself.

2. The Hydro Shop in order to lead the way in electrical merchandising, should be a high-class establishment; one which will be a credit to the Municipality, and to the Hydro, and which will attract people to its doors. This does not mean that in small towns elaborate buildings should be erected just for show purposes, but premises of just a little better than the average store in town should be prepared and kept up to the highest standard of retail stores in appearance, models of cleanliness, order and efficiency, and the clerk or clerks models of courtesy and willingness to serve.

3. In purchasing the stock in trade for the Hydro Shop, the merchandise should be selected with care and discretion, so that only appliances and other articles of sound construction and high quality may be offered to Hydro customers. It is better to lose some sales through failure to stock cheaply constructed or poorly designed articles, than to obtain the sales at the expense of having the inevitable resulting dissatisfaction attach itself to the Hydro Shop. In other words put quality first, and the sales, under proper guidance, will take care of themselves.

4. Do not in purchasing stock of appliances, large or small, be induced to handle too many lines of the same type of appliance. The selection of representative types of the various appliances in use, and the offering for sale of the products of as few manufacturers as possible is strongly recommended. The chief reason for this recommendation is from the point of service, both on new articles being purchased, and on articles sold to customers. With a manufacturer who knows that every other manufacturer of his particular line is selling a particular Shop, the service is very apt to be indifferent, and delays in shipment most likely to follow. Likewise if trouble arises in any of the appliances sold, it is hard to get the manufacturer to take a very live interest in their products where volume of business does not warrant a lot of attention by salesmen and servicemen.

Furthermore, when it comes to carrying service repairs in stock, the fewer the lines being sold, the smaller the stock of repair parts necessary to do efficient servicing of the appliances sold. It is also more satisfactory to train men to service a few appliances than to be compelled to train them to know all about all appliances made and give efficient service to Hydro customers.

5. In merchandising electrical appliances it is most important that resale prices where such are established be maintained. This policy should extend to the point where similar goods may be purchased at any Hydro Shop at similar prices. Co-operation with electrical dealers should also be sought toward stabilizing prices, and price-cutting should be discouraged except in shop worn goods, and even then great care must be exercised to have the approval of all the interests before the sale is put on.

The stabilizing of prices and the fact that goods can be purchased at one price only will tend to establish the confidence of the public in things electrical, and ultimately increase the volume of business for all concerned.

6. Do not look upon private electrical dealers as competitors, but rather as cooperators in the great Hydro scheme. Private dealers do a great service in promoting the use of power in every way possible. Every house that is wired, every motor installed, and every outlet means more revenue from current consumption, and more extended use of power through the medium of satisfied consumers. We need the contractor-dealer, and he needs us—Co-operate.

6½. Do not let the completion of a sale of an electrical appliance end the transaction. Make the customer understand that there is being sold not an article, but the completely satisfactory use of that article. Furthermore do not leave off when that idea has been planted, actually follow it up. Just how far this can be done depends on many things; the degree of enthusiasm and sincerity of the Manager of the Hydro Shop; the amount of financial elbow room permitted by his Commission; the degree of sympathy on the part of the Commissioners towards merchandising by the Hydro Shop; the degree of wealth of the community; the number of other merchants handling electrical goods. These make it impossible to particularize. In general the extent to which the sale of appliances is followed

up in the home should be as great as the financial resources and the latitude of authority will permit. In any event no sale of any of the higher priced appliances should be considered as complete until at least one call has been made by a representative of the Hydro Shop at the home of the purchaser to assist the user of the appliance in learning how to operate it in the correct way.

7. The mere opening of a Hydro Shop does not necessarily preclude that the Shop is going to be a success financially. When a new Shop is opened—and this applies to any Shop, no matter how long established—the Shop should be placed on a proper basis of making it pay its own way, bear its own proportion of expense, direct and indirect, rather than that it be carried along as a burden of the light and power departments of a Hydro Utility. It is only by such a policy that the Hydro Shop can be made to succeed. We must have a proper realization of what overhead expenses are, and what proportion of the selling price of articles sold, constitutes overhead, so that in marking goods for sale proper provision will be made to insure a fair margin of profit, to provide for overhead and leave a little more for contingencies and other things which so often arise to eat up profits.

It is a well-known fact that a very small proportion of central station companies and utilities engaged in merchandising appliances are operating that end of their business at a profit, the majority of them are actually losing money, far more than they realize or will admit; the available information pertaining to the operating costs and margins of profit is almost negligible. It is necessary to pay particular attention to the accounting system recommended in this pamphlet, to see that it is properly kept, so the true costs of operating a Shop and the markups necessary to show a fair margin of profit can be determined accurately and absolutely.

8. There is a tendency on the part of the buying public to compare prices and qualities of goods sold in various Hydro Shops, also to compare the quality of service rendered. By thorough co-operation between Shops the differences existing can be eliminated and customers be made to feel that one Hydro Shop is the same as another no matter where it is located.

This co-operation can also be extended to help one another dispose of slow moving or shop worn goods, and to exchange good selling ideas.

9. While it is desirable to operate a Shop to produce a substantial surplus each year, that should not be the main idea. The offering for sale of the best and approved appliances, having well-dressed windows, doing advertising of a high order, worthy of Hydro, education of the people to the advantages of electricity, and giving the consumer service, should be the first considerations. Surplus earnings should be turned back into the business for the introduction of new devices and the working out of further educational features.

Education And Advertising.

By Education is meant spreading the electrical idea far and wide through the various media at hand, and may be divided into general classes.

Education of the Staff.
" " " Contractor-Dealer.
" " " Public.
" " " Builder and Architect.

It is a deplorable fact that many central stations have among their employees many who are not at all sold on the electrical appliance idea. Yet those same employees are sometimes relied upon to sell appliances to the public, and give such instructions and information as will insure their remaining sold and giving entire satisfaction. Means should be adopted to make it possible for every Hydro employee to enjoy the use of Hydro power to the fullest possible extent. Appliances should be sold to them at reasonably low prices on easy terms, and every encouragement given to enable them to become thoroughly familiar with their operation and costs, to be able to not only talk intelligently to customers but actually boost the use of power to everyone they meet.

The actual selling staff should utilize every means possible towards self-education. The Sales Manager should be a constant reader of electrical magazines, thus keeping himself posted on merchandising methods of others, who have been successful, and various Managers should co-operate to exchange ideas and experiences, which might work to the mutual benefit of all.

All the officers and staff in the various Shops should have talks, at least every two weeks, on the correct method of selling electrical merchandise, and also a discussion on the various appliances being offered for sale, so all may become familiar with selling policies, ser-

vicing policies, and good and bad points of all the appliances on the market.

Conventions of Hydro Shop men and staff are also useful to educate the interested men in one another's ways and ideas, and tend to broaden the minds and viewpoints of all who attend, with the sole purpose of improving their own efficiency and value to their particular Shop.

Education Of The Contractor-Dealer.

As the majority of electrical dealers to-day, are very much opposed to the Hydro Shop idea, it behooves every Hydro Manager to disabuse the minds of these dealers and seek their co-operation and support rather than their enmity.

Foster kindly relations and the spirit of co-operation by discussing common problems with them.

Get them to look upon the Hydro Shop not as a competitor but as a co-worker in extending the use of electricity.

Convince them that the entering of Hydro into merchandising will increase rather than decrease their volume of business.

Assist them in every way possible to sell the electric idea to the public by explaining fully the theory and application of Hydro rates as applies to the operation of electrical appliances. Supply them with all the statistical information possible to insure appliances being properly sold, and to insure also satisfied consumers, and reduce to a minimum complaints arising from over consumption, large power bills, and unsatisfactory operation of appliances in use.

The education of the public of course is the big problem; a thoroughly educated populace would make the electrical business a bonanza unparalleled in history. As it is at the present time, the surface of potential possibilities of the electrical appliance business has only been scratched.

The education of the public must commence with the idea of having houses and buildings properly wired or re-wired to meet every present and possible future need electrically. The public must be shown the advantages of heavy wiring, and sufficient convenience outlets in the home and also of having the proper provision made for such things at the time the original wiring is done, to minimize expense and future inconvenience.

The Electric Home Idea is a splendid way to accomplish this object, and can be successfully carried on in large centres with the co-operation of the contractor-dealers and appliance manufacturers. Follow up of the prospects from an electric home is essential to complete success, that is while the idea has impressed visitors to an electric home, salesmen should continually call on these visitors before they lose the enthusiasm and desire for electrical conveniences, which they saw so well displayed, and so ably demonstrated.

Education of the public can also be carried on through the medium of the press or the Hydro Bulletin, the "Lamp", by means of which all the information available concerning operating costs, installation costs, and other general information about electrical appliances will be continually published, and if these bulletins get into every home there are bound to be results which it might take an unlimited time otherwise to accomplish.

The builder and architect requires to be shown too the value of electricity in the home, so that when houses and other buildings are being designed and constructed, if the prospective owner is not thoroughly sold on the electrical conveniences, the designer and builder can clinch the idea when it will do most good.

Advertising.

Outside of the general publicity campaigns which might be carried on to encourage the use of electricity, individual shops are required to advertise in various ways the different appliances they have for sale, their prices complete with installation added, and the terms which can be extended to customers for easy payment.

It will be the ultimate aim of the Merchandising Committee to have a Central Bureau direct the advertising for Hydro Shops, by having a central Advertising Agency prepare copy and suggested advertisements, and have cuts and mats furnished to the various Shops periodically on a definite schedule, which will permit of advertising appliances at the proper time of the year.

Shops should also tie-up their window dressing with this advertising, to insure maximum return for money expended.

Servicing.

No Hydro Shop should embark upon the merchandising of electrical appliances unless it is fully prepared to render the very best repair and maintenance service, which its resources will permit. Almost every electrical device contains one or more parts subject to deterioration, or wear, and the purchaser of the article is entitled to a

service which will renew these parts when they fail, with the greatest celerity and at moderate cost.

The policy governing servicing will be influenced largely by the same conditions as those governing the follow up of sales, and will depend upon the latitude given the Manager by his Commission financially, or otherwise, but it is of great importance that every endeavor be exercised to bring about a condition where electrical appliances can be properly serviced to the full satisfaction of Hydro consumers.

The extent to which repairs can be made without sending articles back to the factory depends largely upon the size of the Municipality, and the Shop must be guided by local conditions, but the basis of the policy is simple, and may be stated as follows: —

Repair parts should always be kept in stock and facilities provided for making repairs locally, up to the limit of the resources of the Hydro Shop. Repairs required beyond those resources can best be made at the factory, where the goods originated from.

Lending appliances should be kept on hand so the consumer can use an appliance while his own is being repaired.

Special attention should be given by the Manager to speed the execution of repairs, and a high grade of workmanship which will ensure to the owner an appliance returned in first-class operating condition; unmarred by its trip through the repair Shop.

It is of prime importance to the Utility to keep all the appliances in the homes of its customers at work, not lying idle on the shelf owing to breakdowns or defects. To keep them operating continuously it is necessary to get into the homes of the consumers, and each Hydro Shops must devise the method best suited to its own peculiar local condition. In some cases a meter reader can obtain the entree. In other cases a special man can be assigned to the duty, but it is impossible to lay down any one scheme capable of universal adoption. The principal thing is to institute a systematic canvass of every customer's appliance list, to see that nothing is left undone, which will insure 100% operating efficiency, for all the appliances consumers own.

I will read a little of the introduction of the Hydro Shop accounting system.

Every Hydro Shop in order to justify its establishment must conduct merchandising business along strictly business principles. One of the most important—yes—the most essential requirement of a modern business institution is an adequate accounting system properly designed to suit the particular business to which it is applied, to bring to light accurately the true operating condition of that business.

Electrical merchandising dealers, and Hydro Shops particularly, have been slow to realize that they are business institutions, and that the common rules of commerce apply to their operations. Recent developments, however, some political, others financial, have brought us to the full realization of the responsibilities devolving upon the management of a Hydro Shop, so as to avoid criticism, and a too oft repeated expression that Hydro Shop competition is unfair, and that electrical dealers find it financially impossible to remain in business in the face of such competition.

In designing an accounting system for a Hydro Shop, the principle functions of such a system must be considered, and plans laid accordingly. Briefly stated, these functions may be classified as follows:—

1. The accounting system must be designed so as to show the amount of money invested by the Utility to carry on the merchandising business. This is generally represented by the value of the inventory in saleable material and equipment, and in Accounts Receivable, reduced by the amount of surplus the business has accumulated.

2. To show the value of the inventory of saleable material, so that its proper relation to sales can be main-

tained. "Profits are made on turnovers, and lost on leftovers." Roughly speaking, a turnover from four to six times the inventory is essential to successful electrical merchandising.

3. To show the value of Accounts Receivable, so as to be able to judge the efficiency of existing collection methods, or of the plan adopted for time sales.

4. To show the cost of doing business in sufficient detail to permit of an intelligent analysis being made of the operations of the Shop, so as to be able to determine the relation between overhead expense and sales, also between overhead expense and the cost of merchandise. It is also desirable to be able to compare costs with those of other Shops operating under similar conditions.

5. To show the provision made in all sales to cover overhead expenses, and allow a sufficient margin of profit commensurate with the volume of business done. This margin of profit is necessary to provide for contingencies which may arise due to depreciation of inventories, bad debts, and business depression.

6. To provide an intelligent and detailed operating statement, which will reflect the true condition of the Shop's operations.

7. To provide a balance sheet complete and separate from that of the Utility generally for further comparison as may be necessary.

That is in general an outline of what will be contained in the Bulletin which will be issued. If there are any questions any of you would like to ask or any further explanation you would like to have made before we go to the range installation discussion I would be glad to hear from anyone.

A Delegate: Did I understand you to say your stock should not run up to more than one-quarter of the turnover?

The Chairman: If you do $100 worth of business you must have sufficient ranges to be able to sell one; this would make the turn-over equal to the stock carried. If you are doing business on a 5, 10, 15 or 20 thousand dollar basis, you must have sufficient stock on hand.

A Delegate: You consider that stock should be turned over four times during the year?

The Chairman: That would apply to a large institution. If a Shop is buying from the catalogue it will naturally have a very small stock and may turn over what stock it has twenty or thirty or forty times. There are many Shops which do not carry much stock, they sell a lot of appliances, but generally speaking if you have a Shop at all, a place where people can see appliances on display and you are doing any kind of business three or four times the value of the stock should be the turnover.

Following the discussion we had up at Orillia last summer, I canvassed all the municipalities in an endeavour to find out what they were charging the consumer for installing ranges, and to find out, if possible, what constituted the cost. I got replies from a great many of the municipalities and the information submitted was so diversified that it was pretty hard to do anything definite with it. There were not two municipalities which had adopted the same basis of charging consumers, even

where a flat rate was in use, and municipalities which were dealing on the time and material basis had prices which were not at all uniform. Just for comparison I took five different installations all 3 No. 6-60 Ampere services: One in Walkerville where the consumer paid $27.50, the different items making up the cost to the installing contractor totalled $18.90; that is cost, not the selling price; that included all the material that was used, and the labour. One from Exeter in which the total selling price to the consumer was $35.03. Another one, Ottawa, where $49.50 was the selling price to the consumer, here too the selling price of the various items totalled $45.46, this gave 10 percent. profit to the Shop. In Lindsay the selling price was $45.61 and the various items totalled $53.25; this represents a loss to the contractor of 20%. In Stratford the selling price was $35.00 and the cost to the utility $23.08. Glancing over the different items in the list show you the variation in some of the costs. In one case a 60 Amp. service box is shown at $6.75, the next one $10, the next $7, and the next $10 and $4.15; labour charges vary as follows $3.70, $7.30, $14.30, $17, $5.25. Looking over the different items in the list in some cases there is very little difference between the amount of material used which shows that either the men who have been installing the ranges have been asleep on the job, soldiering, or else the other fellow has been working 100 percent. of his time. He has been working with the idea of cutting the cost down and giving what the other chap does for an unlimited cost.

As I mentioned previously on account of the discussion that arose at Orillia in the summertime on the cheapness with which some of the municipalities are installing ranges, Mr. McPherson, of Walkerville, the contractor who installs the ranges for the Walkerville Hydro, has consented to explain his methods of installing ranges for $27.50 as a cost to the consumer or cost to the Hydro Shop.

I will call on Mr. McPherson to explain his methods. I want you to feel perfectly free to ask Mr. McPherson all you like; razzle him as much as you can; if we can get any good information out of his methods it might be well to get all we can.

Mr. McPherson: No doubt you will think I am either crazy or else the other way. We put in ranges at $27.50 showing a profit of 40 percent., and we put in ranges in from 35 minutes to two hours; the quickest range job I know of is 35 minutes.

A Delegate: How many men?

Mr. McPherson: Two men, no helpers—two journeymen electricians.

A Delegate: What do you pay them?

Mr. McPherson: A dollar an hour.

The Chairman: Explain your procedure, Mr. McPherson, from the time you get your instructions from the Walkerville Hydro that there is a range service to be installed up to the time you get your money.

Mr. McPherson: The first thing the men do they go to the Hydro to see if there is a range to be delivered, and if there is they take the range on the truck and go down to the Shop and put on all the material that they require and we carry three different services, provided we do not know the district the house is in. They carry a 10 foot

service, a 15 foot and 20 foot, and in between they probably have two lengths of inch conduit, maybe one is two feet and maybe one three feet. The services are all made up that way and the men look at the house and figure on just what service is required to be put up. While one man is doing that the other man is probably taking the material to the basement. They put their range in place on the floor where it is to be left and one man goes outside and cuts off his service. While he is getting his service cut off the man on the inside takes down the old service; when he gets that down he punches a hole in the wall and puts through his inch conduit and the man on the outside is doing the same thing, he puts his service up and he comes inside, and by the time he gets inside the other man has it all connected up, and both working together they make the necessary joints, and fifteen minutes after the man comes in from outside they have the joints all made and the job is complete.

A Delegate: Do you allow time from the time you leave the Shop until you go back?

Mr. McPherson: We give them two hours to work on, unless it is away out —our district runs sometimes 14 or 15 miles.

A Delegate: You do the trucking?

Mr. McPherson: Yes, we are allowed $1.25 on deliveries.

A Delegate: Are there many stone houses you have a two foot wall to go through?

Mr. McPherson: Not very many.

A Delegate: What about when the meter is up in the attic?

Mr. McPherson: We do not have meters in the attic—they are very very rare.

A Delegate: Every house is wired with three wires?

Mr. McPherson: No, not in that district.

A Delegate: These services are prepared before you leave the Shop?

Mr. McPherson: Yes, they make up the services in 15 minutes in the Shop, and are an hour on the job; we have a standard bending machine and they can bend and put the wire in in 15 minutes. They come in off a job probably at four o'clock and make up three or four services in their spare time.

A Delegate: That is all included in the cost?

Mr. McPherson: Yes, I keep two men doing nothing but range work; they are at that all the time.

A Delegate: Don't you find conditions differ on different jobs?

Mr. McPherson: I have lived in that district for a long time and know pretty well the class of house we are going into.

A Delegate: Does that cost cover going through concrete walls?

Mr. McPherson: Most of our walls are cement block.

A Delegate: How do you work the cable going from L.D. into D.?

Mr. McPherson: We do not use them, we use the gooseneck, we bend goosenecks up to 2¼.

A Delegate: The length going in—do you take it as it comes?

Mr. McPherson: They make their bends 11½ inches and they allow for the board, box and fittings.

A Delegate: What do you do in thicker walls?

Mr. McPherson: The inch service can be used and in those cases the bend is flexible. It can be extended three or four inches.

A Delegate: What is included in your overhead?

Mr. McPherson: My overhead for last year was about 16 percent.

A Delegate: What do you allow there for uncontrollable time on the job?

Mr. McPherson: What do you mean uncontrollable time?

A Delegate: Where a customer comes down and asks where his stuff is going to go and takes up the man's time—you have to answer them.

Mr. McPherson: Not necessarily.

A Delegate: What is the average distance from the entrance box to the range?

Mr. McPherson: About twenty feet.

A Delegate: We have had a case where it is fifty feet, would you do it for $27.50?

Mr. McPherson: Provided it was in my district and came under the contract.

A Delegate: You do not figure you could do it for $27.50?

Mr. McPherson: No, on a fifty foot job I would lose money.

A Delegate: Do you change the location of the meter?

Mr. McPherson: We have a lot of houses where the meter is in the kitchen or dining room, but they are usually in the basement or if they are not we move them to the basement and we charge $5 for that.

A Delegate: Do you ever find a case where you have four or five circuits and the meter on the verandah?

Mr. McPherson: We have no conditions like that, if we do they are very rare cases.

A Delegate: Do you use B.X. cable?

Mr. McPherson: Flexible conduit.

A Delegate: How do you do about grounding; how long does it take to do that?

Mr. McPherson: The average house as it stands, it is not much of a job when you are running from the basement.

A Delegate: What method do you use?

Mr. McPherson: We use No. 10 wire; it is in the house, and usually running the same way as the joists. If we have a very long run to make, ten feet or better, we ground from the cable to the water pipe, if it is a cold water pipe. I think probably our inspection system is a little different to what you have here.

A Delegate: Don't you ever run into trouble with furnace pipes, etc. getting in your way and taking up a little time with your overhead 16 percent. on a straight contract basis?

Mr. McPherson: It is a straight contract.

A Delegate: You do not manage a store?

Mr. McPherson: No, just manage a workshop.

A Delegate: You do not make any inspection of conditions before your men go?

Mr. McPherson: Once in a long time probably if I do not know the place. I have lived in the town all my life and know practically all the houses in every district, and one of the men who puts in ranges is also very familiar with the town, and if you stop to think you can probably picture the

class of house you are liable to meet.

A Delegate: Do you ever run across a house that has about thirty lights on one circuit, and do you take care of that without extra charge?

Mr. McPherson: We can usually find a way past the meter; if the inspector comes along and finds any fault we have to fix it up if it is not much of a job we can take care of it.

A Delegate: Can you give us in detail the cost of items that go to make up the charge?

Mr. McPherson: Well I can give you the exact cost of each individual piece of material that goes in; I can give you the cost of two days, but it is one day's work performed on December 18th., a week before Christmas. We installed four ranges—two men.

55'—1" Conduit	$ 8.80
200'—No. 6 R. C. Wire	8.48
4 —1" Lock Nuts	.10
4 —1" Bushings	.24
4 —F. Condulets	2.16
4 —1" 3 hole covers	.72
4 —60 amp. Ent. SW.	17.00
24 —½" Federal Bush	.72
4 —¾" " "	.12
81 —¾" Flex. Conduit	10.00
360 —No. 8 R. C. Wire	9.13
8 —No. 255 T. B. Con.	1.36
6 —No. 90 Clamps	.60
10' —No. 10 R. C. Wire	.16
3 —No. 62588 Cutouts	.69
1 lb. Sheet Asbestos	.14
20' —¼" Loom	.60
Total Cost of Material	$61.02
Permits	4.40
Labor	14.00
Total Cost—	$79.42

That $79.42 is for the four jobs, and the Hydro allowed me for the four jobs $115.

A Delegate: What do you say the labor was?

Mr. McPherson: $14.00. Out of these four jobs we took out the wiring that had been there and used in their lighting service, and things like that, and that included the following items which we took back into the Shop and use them as we can.

Credits

4—30 Amp. Service boxes	$2.80
2—½" Lock Nuts	.03
2—½" Bush.	.05
1—¾" Lock Nut	.01
1—¾" Bush.	.03
45—½" Conduit	3.60
7—¾" "	.70
2—½ B. Condulets	.40
21—Federal Bush.	.63
	$8.25

The total material taken off the jobs is $8.25 and that brings the jobs down to $71.17 for the four jobs after deducting the $8.25 of a credit. That leaves me a total of $43.83 on four range jobs or $10.96 each.

The Chairman: The material cost you have there is the cost to you?

Mr. McPherson: These prices are taken from Henderson's inventory issued this year. What I have given you covers four ranges we put in last month, and I have also the figures covering seven ranges which we also installed.

A Delegate: You do not take care of any truck mileage?

Mr. McPherson: You have $43.83 gross profit off an investment of $71.17.

A Delegate: The cost of delivery is not in there.

Mr. McPherson: I charge that to the Hydro. The wiring amounts to $27.50.

A Delegate: Do you put a cut-off switch at the range?

Mr. McPherson: No, a 60 amp. box. If the service is not bigger than a No.

6. If it is a No. 4 service we install the range separately.

A Delegate: What items do you include in your 16 percent. overhead, what constitutes your overhead?

Mr. McPherson: Rent, cost of doing business in general, the same as any ordinary business.

A Delegate: Have you any system for taking care of your individual payments that go to make up the overhead?

Mr. McPherson: No.

The Chairman: This material you take off the job you keep that, you do not credit the consumer?

Mr. McPherson: We keep that.

The Chairman: I might say that Mr. McPherson got his education in the Ford Motor Company's plant in three or four different departments, and he has imbued Ford's ideas into the wiring of a house, which is not a bad plan as you will no doubt gather.

Mr. McPherson: I put in seven or eight from January 1st. to 10th.—I will not go over this material, it is practically the same as the last sheet. The total cost of labor, permits and material was $124.16 on seven ranges I took off the credits for materials which amounted to $16.26 on the seven ranges, leaving a balance of $107.90 which figures $14.05 for each range.

A Delegate: You say you had $14 for time.

Mr. McPherson: Yes.

A Delegate: They actually installed four ranges in seven hours?

Mr. McPherson: Practically, yes, that is two men.

A Delegate: Are your services available for other cities?

Mr. McPherson: No, I hardly think so. I am quite satisfied where I am. To tell you the truth I cannot see anything really remarkable about it; if you stop to think it is getting down to a system where you know where you are at. When I went into the contracting business I lost a lot of money and lost a lot I didn't have and managed to get straightened out one way or another, and to-day I am in a fairly good position to do contracting business, and I am in that position because I went out to work myself. If I have two or three hours a day to spare I do not run around someone's office and waste it. I am good to the men and if they are two or three days sick they are not docked; the only time they are docked is when they have been out the night before and do not come back next morning.

A Delegate: What type of fuse do you use?

Mr. McPherson: The Hydro service fuse.

A Delegate: Do you use a cutout on the range service?

Mr. McPherson: If the service is a No. 6 we do not use it.

A Delegate: In our district they make us use the L.B.

Mr. McPherson: There are no complaints against the goosenecks.

A Delegate: Do you use a steel box?

Mr. McPherson: No.

A Delegate: All open?

Mr. McPherson: Yes.

A Delegate: Does your price cover the installation of a 76 amp. range?

Mr. McPherson: Really to tell the truth I do not believe we put in a 76.

A Delegate: The ordinary cabinet range is about 76 amps.

Mr. McPherson: I thought they ran from 54 to 60.

A Delegate: If it calls for a No. 76?

Mr. McPherson: It is up to the inspector to decide.

A Delegate: What part of the house do you put the service on?

Mr. McPherson: In Walkerville they are all practically an alley service and the same applies to Windsor.

A Delegate: You have a much longer run than 20 feet.

Mr. McPherson: You will not find so many in the front of the house.

A Delegate: Your firm does not bring the wires to the front of the house?

Mr. McPherson: We do that, we connect up wherever the service comes in. It might mean a lot but we do the work according to the contract.

A Delegate: What type of 60 amp. box do you use?

Mr. McPherson: We can use anything.

A Delegate: I am quite satisfied this condition is all right, but it does not apply to the average condition.

The Chairman: It was never contended that what suits one municipality would suit another. At the same time there are certain methods that are employed which I think might well stand emulation. Of course when you analyze the cost as used in Walkerville you will see the system used by Mr. McPherson where he keeps track of every little detail in connection with the installation from the time the order is received and during the time the men are on the job right to the finish. The amount of material used is always a pretty good criterion of the amount of labor that should be utilized to put the material into use. If a man uses a 14-foot conduit he is not going to cut that up into 14 pieces; another fellow uses 15 feet and there is about the same amount of labor to put it on the wall. If another fellow uses 35 feet you would naturally expect there are going to be a couple of bends and a few more joints to put in, and naturally labor would be a little more, but there should not be such a difference as there is between $3.70 and $17 for the installation of a 60 amp. service.

A Delegate: How would that rate compare to Windsor which is right close?

Mr. McPherson: Windsor's installation price is $28.

The Chairman: They have not the same method of installing ranges as in Walkerville.

Mr. McPherson: We have as one of the inspectors of the Border Cities a man who is very reasonable. If you get into a job where you might require advice from him you call him up and ask him if you can do a certain thing and he would look at it and would say yes, but if you did not call him up and he found out what you were doing he would probably throw the job out.

The Chairman: At the same time he is living up to the rules?

Mr. McPherson: Yes.

The Chairman: If he is living up to the rules of the Code Book a general inspection should not do any harm?

Mr. McPherson: He is a man who has worked on electrical work and knows what he is talking about. You take a man out of an office and give him an inspector's job he might make a good engineer but a poor inspector.

A Delegate: There is a great deal of

difference in the manner in which the Inspection Department makes you do work in different municipalities. I know when the man comes from Hamilton into the Town of St. Mary's he condemns stuff which we put in and which has been passed by our inspector.

The Chairman: You have not a flexible inspector.

A Delegate: The same thing exists in Niagara Falls.

A Delegate (St. Mary's): In St. Mary's our cost to the consumer is about $40, and in other places for the same installation it is $60, and we are up against that trouble all the time. The hardware stores in St. Mary's feel that we should not be doing business and are doing this work from time to time much lower than we are. I would like to ask Mr. McPherson in connection with putting in a service box, supposing a customer says I want it brought in the back; in that case do you run all the way back on the outside of the wall—it might make a 40 foot service? Do you make a special service supposing he objects to having the wires go up the side? We had a case where we were running three No. 4's and the job was a $90 job, and we should have put it in for $55 but the man had to have it done in a certain way. He wanted a lot of provisions made for extensions should he require them.

Mr. McPherson: It is up to him to pay for it.

A Delegate: That would be an extra?

Mr. McPherson: Yes.

A Delegate: Your installation is standard?

Mr. McPherson: Yes. I think where we save a lot of time is that the men take the range with them; the range is there and they take their tackle directly to the job.

A Delegate: You do not assemble the range?

Mr. McPherson: They are all assembled for us, and that means quite a bit, you have everything there to work with.

The Chairman: Gentlemen, if you have any questions to ask I wish you would stand up.

A Delegate: I would like to know if the price of $27.50 applies to any house in the city or district?

Mr. McPherson: Applies to any house in the Border Cities; we cover a territory of about 25 miles. You must understand the Walkerville Hydro have to pay excess cartage outside of the city limits. We have a scale we work on, the more miles, the more it is.

A Delegate: Do you have any difficulty in getting to a place and having the man say that the service is not to be put where you figure on putting it, and in that way it costs more?

Mr. McPherson: We charge $5 for moving a meter from the point where the meter is when we go there.

A Delegate: Do you think a system of having the services uniform would be satisfactory? In connection with this you would never find two houses the same. Do you know of any town in Ontario where all houses are the same?

Mr. McPherson: I hardly believe you can make up a standard service in the Shop. In one case you will find the job is a four foot job and the next

an eight foot job, and the walls will run in varying thickness, but in those cases you can take the gooseneck and cut off any amount that is necessary; the gooseneck can be bent to suit the necessity and there is very little work at all.

A Delegate: Why is it in some towns they charge for running the meter service to the house from the street?

Mr. McPherson: That would apply in rural districts.

A Delegate: That runs in some cases from $10 to $12, depending on what property they have between the street line and the house. Why should that be charged?

Chairman: It is the local policy everybody understands, and when they ask for a service they know they have to pay for the service. The same applies on water services and gas services in some municipalities where they have these local utilities. It is generally understood by the people in the municipalities.

Mr. Tobin: Last year when the question came up at Orillia I made a statement and it came in for some criticism when I said we should make money in doing our own wiring. Before I came to the Convention I had the girl in the office go back over the books and pick out the jobs we had done and set forth the total amount we received. You understand we do general contracting. All the wiring we did from the 1st. January up to the 31st. January including the cost of material and cost of labor and overhead expenses—we had about 500 odd jobs—our total for that was $14,865; of that $7,334.00 was material cost, $3,167.00 was labor cost, giving us a gross profit of $4,364.00 on that wiring, and that gross profit represents about 29 percent. plus on our selling price or about 40 percent. plus on our cost price. We do our own wiring, and have our own wiring department. Prior to that we had outsiders doing that work, but we did not get service and satisfaction and we decided to do it ourselves. We have now our own wiring foreman who looks after the services and the service men outside of selling any appliances. In our wiring, our wiring inspector goes out on the job and figures the material he is going to require and he comes back and hands that in and we have a boy who does nothing but make up services. When a man is ready for a job, the material the foreman requires for the job is already made up and is taken to the job. Sometimes the foreman does not come back for a week, in fact I have known times a man has not been at the Shop from Saturday morning till Monday for two weeks at a time.

I feel it is a good thing for the larger Shops to operate their own wiring department. They get better service and have better control over installation, and they will make more money. We used to get requests for wiring houses and we would say all right we will get this other man to go over and it was not always the best thing, and since that time we have been doing all our own work in connection with wiring and are very well satisfied.

A Delegate: What is your charge?

Answer: We charge a flat rate of $35 for No. 6 and $45 for a No. 4, and it does not make any difference

whether the meter is in the attic or in the basement.

Question: Where are most of the meters?

Answer: The most of them are in the cellar, odd ones are in the attic.

A Delegate: There are two items which enter into the low cost of installation to the consumers, in the Border Cities. One is the fact that we are able to get such a low price from Walkerville, which is $27.50 by Mr. McPherson, and I venture to say we could get half a dozen wiring contractors to do it at the same price. One reason they can give us that price is that we have such a large volume of range installation, more I believe in the Border Cities than other municipalities, and to show the people do not have anything to do with the Hydro we last year sold 1,043 ranges and we only wired 470, in other words more than half of the ranges which we sold the wiring for same was done by some other contractor. The second item which enters into the low cost is the fact that we pay our contractor $28 and we sell to the consumer for $28.50, and I do not think that is a fair margin of profit; we do not make a profit on it. The fact remains those prices are set, and competition keeps us at those prices. We ought to have a profit.

A Delegate: What happens, Mr. McPherson, where you have a house that has a lot of other electrical equipment, is it still done at the same price?

Mr. McPherson: Our flat price only covers three No. 6's.

A Delegate: How do you determine in selling a range what size wire it is going to need?

Mr. McPherson: The way that is taken care of, the customer comes in and asks for a price for installation, saying they have a standard system and we tell them the price is going to be $27.50 When the contractor gets on the job we find that the customer wants a base plug put in.

A Delegate: Supposing he has other equipment, supposing he has a No. 6 and you take the job for $27.50, and you find a No. 4 or No. 2?

Mr. McPherson: That all depends on where the house is situated. If there is no other electrical equipment, or if they find through error they have misrepresented the conditions at the time of selling the range—unless the conditions are as they state the price will not be $27.50. If we go out and find they have other equipment we quote a price and get them to sign a contract and the price quoted is $27.50 and if it is found that it is going to be more than the price quoted the customer must come in and make satisfactory adjustment. The dealer must have a contract signed agreeing to pay more. That happens very rarely, and it is only once in a long time that it is found the price exceeds that named in the contract. 85 percent. of the installations are made on the basis of $27.50.

A Delegate: What do you do to protect yourself in a case where a customer may come in and want a 3,000 watt heater or something of that kind to be carried on three No. 6 service wires?

Mr. McPherson: Three No. 6's will take care of a range and a water heater or a range and a fireplace.

A Delegate: Along with lighting?

Mr. McPherson: I do not know.

A Delegate: In small houses it might.

Mr. McPherson: We generally know the type of house very well throughout our district, and the houses are not as big as you have in Toronto, and we are acquainted with local conditions probably better than you are.

A Delegate: What is the carrying capacity of three No. 6 wires?

Mr. McPherson: 60 amps.

A Delegate: Your ordinary cabinet range is 76 amps, and the water heater is 108.

Mr. McPherson: 76 amps would be 110 volts, and you can put on as much equipment as you like so long as you do not go over the 60 amps.

Mr. Heeg: If the discussion is closed on this subject I take great pleasure in moving a hearty vote of thanks to Mr. McPherson. I know from my experience that the question of putting in services and the charges in connection therewith has been one that has been the difficult part of the business and the information Mr. McPherson has given us to-day is worth the time, and I take great pleasure in moving a hearty vote of thanks.

(Motion duly seconded and carried with applause.)

The afternoon session was occupied by discussion on standardizing prices of appliances and installation of appliances in the various Hydro Shops and culminated in the appointing of a Committee as follows:—

Mr. Tobin, of Stratford,
Mr. Blay, of London,
Mr. Stewart, of Toronto,
Mr. Phelan, of Windsor,
Mr. McColl, of Walkerville,
Mr. Chase, of Bowmanville,
Mr. Cole, of St. Mary's,
Mr. Childs, of Hamilton,
Mr. Mickler.

to look into the matter of existing prices on the various types of appliances large and small being sold in Ontario and to report their findings at a future meeting to be held at an early date. The discussion on this question is very long and as no definite recommendations were put forward it is not necessary to publish all of the discussion in detail.

The question of the continuation of the publication of the Hydro Lamp Bulletin was put up for discussion and it was unanimously decided that the Lamp should continue in its present form as it was felt that it was performing a very useful function and met with the approval of Hydro Officials and Hydro Consumers alike.

As the time was opportune for advancing a little information about inspection and testing of Hydro Lamps Mr. Cousins, of the Hydro Laboratory, described fully how Hydro Lamps reach their high state of perfection by outlining the routine of inspection at the factory and the testing done at our Laboratory on lamps which are made to bear the Hydro Label. A great many questions concerning the guarantee of Hydro Lamp, the method of making replacements and so on, were discussed and it was felt that the men actively engaged in selling Hydro Lamps are a little better equipped to talk about the Hydro Lamp than heretofore.

This ended the programme for the day and terminated what was acknowledged by all to be a very successful Merchandising Session.

Reports

Auditors' Report

Toronto, January 17, 1924.

Mr. J. E. Phelps,
Vice-President, Association of Municipal Electrical
Utilities of Ontario.

Dear Sir,—

We beg to advise you that we have audited the accounts of the above Association for the year 1923, and find that the amounts shown on statement given below as being received are certified to by the Secretary as being the total receipts for the year, disbursements are supported by properly authorized vouchers, and the cash balance as shown to be on hand is in accord with the bank Pass Book.

STATEMENT OF RECEIPTS AND DISBURSEMENTS FOR YEAR 1923.

RECEIPTS:

Balance in bank January, 1922	$ 985.92	
Municipal fees	1,319.50	
Manufacturers' fees	350.00	
Convention Dinner, January	366.00	
Convention Dinner, June	297.00	
Interest on Bank Account	34.86	$3,353.28

DISBURSEMENTS:

Printing, postage, etc.	421.03	
Travelling expenses	280.74	
Banquets	791.50	
Reporting	179.75	
Entertainers	66.00	
Bank Exchange	13.30	
Gratuity to Secretary	100.00	
Balance in Bank	1,500.96	$3,353.28

Respectfully submitted,

R. C. McCollum
Sgd. W. G. Pierdon
Auditors.

Regulations and Standards Committee

The Commission's Book of Rules and Regulations for Inside Electrical Installations has undergone thorough revision both in order to eliminate useless material and to embody new features.

The language, which in some instances was borrowed from the National Electrical Code, has been improved, and the meaning of all rules has, as far as possible, been expressed so as to make their intent very clear.

All new matter contained in the 1920 Edition of the National Electrical Code and in the 1924 Edition of the National Electrical Code has been carefully sifted, and such portions as it seemed to be desirable or necessary to insert in the Commission's rules have been embodied in the draft now prepared.

In the draft presented the objectionable features have, it is believed, been entirely eliminated. The rules have been, as far as possible, rearranged in such a manner as to do away with the necessity for repeating one rule several times under different headings—in carrying out this scheme it was found possible to discard many rules of a repetitive nature, thus reducing the total number and simplifying the whole book.

Further, careful consideration shewed that several rules were unnecessary, particularly some which cover points now taken care of by the Approvals Laboratory; again a number of rules have been taken out as being entirely unnecessary since it was found to be possible to adequately take care of them in the General Rules which must obviously apply throughout the whole book.

In some cases whole sets of rules have been rejected as is shewn later.

It is further proposed to reject most of the illustrations, which have been a feature of former editions of the Rules and merely retain those of a diagrammatic nature illustrating methods of construction or connection.

A number of new definitions have been added and there are now some general recommendations inserted towards the end of the book.

In the "Miscellaneous" section the rules under "Constant Current Systems", "Electric-Gas Lighting" and "Signalling Systems" have been taken out, as have also those under "Car Wiring and Equipment of Cars" though the rules under "Car Houses" have been retained with some revisions.

A new section entitled "Outdoor Installation Work on Private Property and Premises" has been added under the heading "Miscellaneous".

A new set of rules on Radio Installations which was drafted by a special committee, in 1922, is being sent out to the members of the Main Committee was presented for discussion.

A meeting of the Main Committee on Rules and Regulations (Inside Work) was held on January 10th., 1924.

At this meeting the new draft of rules as prepared by the Sub-Committee was presented for discussion.

After the Chairman had briefly outlined the work done by the Sub-Committee, the Secretary brought forward for discussion, one by one, those rules

which were new or else were sufficiently changed from the original to warrant special consideration by the Main Committee. The great majority of these rules was approved of without change and, in a number, minor alterations were proposed and in some cases adopted.

After the whole of the draft of the new rules had been covered, the subject of "Conduit Wiring with a Bare Neutral" was brought up by the Chairman.

There was a considerable amount of discussion on this proposed system of wiring, and it was generally recognized that it had the merit, where grounding conditions are favorable, of greater safety than present systems, particularly, in relation to such matters as the use of electric heaters in bathrooms, where the menace to life is becoming serious.

Finally, Mr. Heeg moved that the system be given a trial, and Mr. Wills Maclachlan seconded this motion, which was carried.

Mr. McKay, who represents the Electrical Manufacturers, was, unfortunately, unable to be present at the meeting during the time when this system of wiring was being discussed, and he made a special request later, which was acceded to, that several of the representatives of the manufacturers be given an opportunity of meeting the Sub-Committee on Rules and Regulations (Inside Work) so that their views might receive consideration.

Eleven electrical manufacturing firms were represented at this meeting by thirteen representatives.

With the sanction of the Chairman (Mr. A. G. Hall) Mr. J. H. Hall (C. G. E. Co.) put the following motion:—

"That in the opinion of the manufacturers represented at this meeting the time is not opportune for the changing of the wiring regulations to permit of installations with a bare neutral.

This was seconded by Mr. E. Edgar (C. G. E. Co.) and carried (by the manufacturers' representatives) unanimously.

The members of the Commission's staff present at this meeting took no part in this motion.

In 1922, a Committee was appointed to prepare rules on Radio Work, these rules, based to some extent on the then proposed rules of the N. B. F. A. were drafted, but held over, pending the redrafting of the Commission's Book of Rules.

The Radio Rules, as drafted, cover stations which receive and stations which both transmit and receive, but it has been thought impracticable to enforce rules for the former, and it is now proposed that only rules for stations which both transmit and receive shall be included in the Commission's Rules and Regulations.

These Rules have not yet been submitted to the Main Committee, but copies are being prepared and will be distributed in a few days.

Minutes of the Convention

The Convention was called to order at the Carls-Rite Hotel, Toronto, at 2.30 p.m., January 24th., 1924, the Vice-President, Mr. J. E. B. Phelps, being Chairman.

The Secretary presented the report

of the auditors which showed a balance in the bank at the end of 1923 to be $1,500.96. At the end of 1922 this balance was $985.92. He also read the following correspondence:—

A letter from the Master of Zeta Lodge, Free Masons, extending an invitation to the Masonic members of the Association to visit that Lodge on the following evening.

A letter from Mr. E. V. Buchanan, London, suggesting that arrangements be made with the Hydro-Electric Power Commission for the publication in the Bulletin of notices of apparatus for sale by the municipalities.

A letter from the Manager of Bigwin Inn, Lake of Bays, asking to have the Association hold its summer convention at that place.

A letter from Mayor Breithaupt, Mayor of Kitchener, inviting the Association to hold its summer convention in Kitchener.

He also referred to a resolution passed at the Executive meeting on October 5, 1923, in regard to a suggestion by Mr. Wills Maclachlan that the summer convention be held jointly with the Canadian Electrical Association and the Canadian Electric Railways' Association, which was referred to the Convention for consideration.

After discussing the suggestion regarding the listing of apparatus for sale, it was—Moved by Mr. E. V. Buchanan, and seconded by Mr. V. S. McIntyre: That the Hydro-Electric Power Commission of Ontario be requested to reserve space in the Bulletin each month to list equipment for sale by the municipalities. Carried

Mr. A. S. L. Barnes presented the report of the Regulations and Standards Committee on behalf of Mr. J. J. Heeg, Committee Chairman. It was moved by Mr. J. J. Heeg, and seconded by Mr. H. O. Fisk: That the report of the Regulations and Standards Committee be adopted. Carried

On behalf of Mr. P. B. Yates, Chairman of the Rates Committee, Mr. E. V. Buchanan, advised that this Committee had met that morning and had adjourned until evening, and a report would be forthcoming on the following day.

The Chairman then addressed the Convention complimenting the delegates on the work they had accomplished in the past and welcoming them to the meeting. He also referred to an invitation from the Executive of the Ontario Municipal Electrical Association to combine the two Associations under the one head. Mr. T. J. Hannigan, Secretary of the O.M.E.A., not being present, discussion of the proposition was deferred until he should arrive.

Mr. R. E. Smythies, Vice-President, Lincoln Electric Company, Limited, Toronto, presented a paper entitled "Recent Progress and Future Development in Electric Welding" which was illustrated by lantern slides. Discussion following this paper was by Messrs. E. V. Buchanan; V. S. McIntyre; M. J. McHenry; J. R. Henderson; H. F. Shearer and O. H. Scott. It was moved by Mr. O. H. Scott and seconded by Mr. E. V. Buchanan: That Mr. Smythies be extended a hearty vote of thanks for his very splendid paper. Carried.

The Secretary presented the report of the scrutineers of the officers elected for the year 1924. There being

no nominees for District Director, Eastern District, Mr. J. E. Brown was declared elected to that office. The officers for 1924 are as follows:—

President:....................J. E. B. Phelps
Vice-President.............V. S. McIntyre
Secretary....................S. R. A. Clement
Treasurer..........................G. J. Mickler

Directors:

W. R. Catton,
O. H. Scott,
M. J. McHenry.

District Directors:

Niagara District............J. G. Archibald
Central District............ J. E. Skidmore
Georgian Bay District....E. J. Stapleton
Eastern District................J. E. Brown
Northern District............R. H. Staford

Mr. T. J. Hannigan addressed the Convention on the proposed amalgamation with the Ontario Municipal Electrical Association. It was moved by Mr. R. H. Starr, and seconded by Mr. H. F. Shearer: That the matter of amalgamation of this Association with the Ontario Municipal Electrical Association be referred to the Executive for consideration and report back to the Association at its next Convention. Carried.

The Convention then entered into the question of fixing the place of meeting for the June Convention. It was moved by Mr. O. H. Scott, and seconded by Mr. J. J. Heeg: That the question of deciding a meeting place for the June Convention be referred to the Executive. Carried.

The meeting adjourned at 5 p.m. At 6 p.m. that evening the delegates met for the Convention Dinner, when Hon. J. R. Cooke, Minister Without Portfolio and Hydro-Electric Power Commissioner, was the guest of the Association. Hon. Sir Adam Beck, Minister Without Portfolio and Chairman, Hydro-Electric Power Commission of Ontario, in a short address, introduced Mr. Cooke to the delegates. Mr. Cooke then gave a short address which was very much appreciated by everyone present.

The Convention resumed its sessions at 9.30 on the morning of January 25th., when Mr. Wills Maclachlan rose to explain that the suggestion referred to on the previous day in reference to holding a joint Convention with the Canadian Electric Railway Association had come from him as a personal suggestion to the former President without any thought of it even being brought up at a public meeting.

Mr. C. E. Schwenger, Distribution Engineer, Toronto Hydro-Electric System, then read a paper on "Voltage Regulation on A.C. Distribution Systems", which was illustrated by lantern slides. Discussion following this paper was by Messrs. H. O. Fisk, H. F. Shearer, E. R. Lawler, H. D. Rothwell, D. E. Charters, J. W. Peart, G. F. Drewry, C. C. Elvidge, J. H. Caster, E. V. Buchanan and T. R. C. Flint.

It was moved by Mr. H. F. Shearer, and seconded by Mr. J. W. Peart: That a hearty vote of thanks be extended to Mr. Schwenger for his very excellent and instructive paper. Carried.

The session adjourned at 11.30 a.m.

The afternoon session opened at 2.30 P.M. when the Chairman introduced Mr. Pratt of the Dominion Power and Transmission Co. Limited, Hamilton, and member of the Canadian Electrical Association, who

expressed his appreciation of the welcome given him by the Association and of permitting him to listen to the proceedings of that afternoon.

Mr. Wirt S. Scott, Manager, Industrial Heating Section, Westinghouse Electric and Manufacturing Company, East Pittsburg, Pa., presented his paper entitled "Industrial Electric Heating for the Central Stations and Manufacturers", which was illustrated by lantern slides. Discussion following Mr. Scott's paper was by Messrs. W. R. Catton, H. O. Fisk, E. V. Buchanan, M. J. McHenry, M. P. Whelan, R. H. Starr, J. A. Harris, H. F. Shearer, C. E. Kirkby, Pease and Miller.

It was moved by Mr. E. V. Buchanan, and seconded by Mr. J. G. Archibald: That the Convention extend a vote of thanks to Mr. Scott for coming and addressing the Association. Carried.

Mr. M. J. McHenry reported on behalf of Mr. P. B. Yates, Chairman, Rates Committee, advising that as a result of the meetings of that Committee, on the previous day, certain suggestions were made with reference to the adjustment of the existing domestic rates that would be presented to the Chairman of the Hydro-Electric Power Commission of Ontario for his consideration. Also that the Committee proposed meeting again in about two weeks' time to consider adjustment of the commercial and power rates, after which a detailed report would be made.

After thanking the delegates for their attendance and discussions on the various papers, the Chairman declared the Convention adjourned at 5 p.m.

In addition to the proceedings reported in the foregoing, the various Hydro Shop Managers and Appliance Salesmen had a separate meeting which lasted throughout the whole of the second day of the Convention. This meeting took the form of a round table conference, and was conducted by Mr. G. J. Mickler. The various problems arising out of electrical merchandising and Hydro Shop management were the subjects discussed.

There were 209 delegates who registered during the Convention being classified as follows:—

Class A	78
Class B	16
Commercial	72
Associates	26
Guests	17
Total	209

There were 238 who attended the Convention Dinner.

Mr. Wirt S. Scott's Paper on Industrial Electric Heating will appear in the March Issue.

List of Electrical Material, Devices and Fittings

Approved by The Hydro-Electric Power Commission of Ontario in January 1924.

Appliances

THE PEERLESS MFG. COMPANY, 122 Wellington St., W., Toronto, Ont.

Portable Floor Waxing and Polishing Machine, "Peerless".

* * *

EMANUEL A. MARTIN, (Submittor), 47 W., 42nd. St., New York, N.Y.

W. H. BANFIELD & SONS, LTD. (Mfr.), 370 Pape Ave., Toronto, Ont.

Air Heaters, Portable Reflector & Convection Types.

* * *

HURLEY MACHINE COMPANY, LIMITED, 66 Temperance St., Toronto, Ont.

Electric Washing Machines, "Thor" Nos. 25 and 32, and "Superior" oscillator.

* * *

MAXWELLS LIMITED, St. Marys, Ont.

Electric Washing Machines, "Super-Vac".

* * *

PITTSBURGH GAGE & SUPPLY COMPANY, P.O. Box 1236, Pittsburgh, Pa.

Electric Washing Machine, "Gainaday".

* * *

DURABLE ELECTRIC APPLIANCE CO., 81 Jarvis St., Toronto, Ont.

Portable Air Heaters.

* * *

MEYER BROTHERS, 101 Queen St., E., Toronto.

Ironing Machine.

* * *

CANADIAN WESTINGHOUSE COMPANY LIMITED, Hamilton, Ont.

Single and double burner Hot Plates, Nos. SH19306, SH20001 and H20002, SH20003, H20004 and H20005.

* * *

PHILIP GIES FOUNDRY, Kitchener, Ont.

Air Compressors — Motor-driven, Models B and C

* * *

*RACINE UNIVERSAL MOTOR CO., 4642-44 Ravenswood Ave., Chicago, Ill.

Electric Hair Clipper, "Race".

* * *

*BIRTMAN ELECTRIC CO., 640 W. Lake St., Chicago, Ill.

Suction Cleaner, "Magnetic" Model 123, "Bee-Vac" Model G.

* * *

*AUTOMATIC ELECTRIC HEATER CO. (Mfr.) Warren, Pa.

SEPCO AUTOMATIC HEATERS LTD., (Submittor), 39 Richmond St., E., Toronto.

Glue Heaters, "Sepco".

* * *

Switches

TAYLOR ELECTRIC MFG. CO., LIMITED, 526 Adelaide St., London, Ont.

Knife Switches two, three and four pole. Cat. Nos. 1123; 2533 S.N.; 2536 S.N.; 25310 S.N.; 25320 S.N.; 2523-252120 incl.; 2533-253120 inclu.; 2543-254120 inclu.; 5533-55360 inclu.; With "Standardized" service switch

boxes. Cat. Nos. S2533 S.N., S2536 S.N., S25310 S.N.

Knife Switches, double-throw, Motor starting. Cat. Nos. 2523M.; 2526 M.; 2533 M.; 2536 M.; 2543 M.; 2546 M.; 5523 M.; 5526 M.; 5533 M.; 5536 M.

Knife Switches, single-throw, 3 and 4 pole. Cat. Nos. 2533 C-253120 C. incl.; 5533C-55360C incl.; 5543C-554120C incl.

* * *

Fittings

BENJAMIN ELECTRIC MFG. CO. OF CANADA LIMITED, 11-17 Charlotte St., Toronto.

Medium Base Sockets "Benjamin". Metal Shell, Key, Cat. Nos. 89480, 89481.

Medium Base Receptacles, "Benjamin". Metal Shell with porcelain bases, Key, Cat. Nos. 86609, 88224, 80022.

* * *

Miscellaneous

*STANDARD UNDERGROUND CABLE COMPANY OF CANADA, LTD., Hamilton, Ont.

Flexible Cord—Rubber Sheathed, Type S.

* * *

*These devices are under the Underwriters' Laboratories re-examination or label service.

THE BULLETIN

Published by
HYDRO-ELECTRIC POWER COMMISSION
of Ontario

190 University Avenue
Toronto

Subscription Price $2.00
Per Year

CONTENTS

Vol. XI. No. 3

MARCH, 1924

Is Your Utility a Member?

ON the first of this month the Association of Municipal Electrical Utilities of Ontario completed the first five years of its existence.

Prior to 1918 it was recognized that there should be some organization that would permit the Managers, Superintendents, Engineers and other Operating Officials of the municipally owned electric utilities in Ontario to come together for the purpose of discussing the various questions arising out of the operation of the systems. With this in view the Engineers' Section of the Ontario Municipal Electrical Association was formed, but after several years of trial it was found that the arrangements under which it worked were not altogether satisfactory. The members of the former organization therefore, after considerable consideration decided that a separate association should be formed.

The Association of Municipal Electrical Utilities was organized for the purpose of furthering the interests of Municipal Electrical Utilities in Ontario and for the mutual assistance of its members, education along technical and commercial lines, and the standardization of methods, apparatus and materials. Membership in the Association is open to all Ontario Municipal Electrical Utilities, either operated locally or by the Hydro-Electric Power Commission of Ontario, upon the payment of certain dues. The amount of dues required from each utility depends upon the number of consumers served.

On the first of March each year the

Association sends to each municipally owned electrical utility a statement showing the amount of dues required from it, to give it membership for that year. Every utility is, therefore, given an opportunity at this time of expressing its wish of becoming a member and of supporting the Association simply by forwarding the amount of dues asked.

The membership list of the Association contains the names of a large proportion of the Municipal Electrical Utilities in Ontario. There are still a number who have not come in. It is in the interest of every utility to be a member and to take part in the activities of the Association. More benefits are to be gained by participation and personal contact with its members than from reading brief reports of its proceedings.

Development of St. Lawrence River Power

THE rapidly increasing demand for electric power during recent years has changed the relative value of potential developments in the Province to such a degree that the complete development of the power in the International reach of the St. Lawrence River, instead of being looked upon with almost universal apprehension that it might find no market for its great output, is now being demanded by power consumers and others in the vicinity of the proposed developments and at very considerable distances therefrom. This change of attitude is due in part to the rapid annual increase in the amount of power demanded in the Province, and in part to the realization that the economic distance to which power can be transmitted has been increasing. This latter feature ot the situation is perhaps affected by the approach to ultimate development at Niagara Falls and the consequent increased value of power to the district covered by the Niagara System. Furthermore, new developments in the Trent System are barely keeping pace with the growth of load, so that industry in the district is handicapped. Large supplies of power readily available at a reasonable price will attract new industries to the district.

The International and Quebec reaches of the St. Lawrence have provided power for industries along the river for over a hundred years. At the present time, some forty power plants are operating with an output in excess of 300,000 horsepower. Among these are the plants at Cedars, St. Timothee, Soulanges and Massena, the first three of which transmit their output to distant points. Many of the other plants supply power for industries located at the power sites.

One of the characteristics of the river that makes it unusually valuable for development on a large scale, is the small variation in flow. During the past sixty-four years the minimum flow has been 183,000 cubic feet per second, and the

maximum, 319,000, a ratio of one to one and three-quarters. The average flow during the period has been 247,000 cubic feet per second. The variation in water level during the year, at most points along the river, is in the neighborhood of two feet, with a maximum range of about five feet for the sixty-four year period. These figures for variation in water level are for open water conditions. Ice jams have formed at times that have caused greater variation than those named.

From Lake Ontario to Prescott, the river is deep and wide with very low velocities of flow, and a fall in water surface varying slightly above and below one foot. A few miles below Prescott, at the head of the Galops Rapids, a ridge of hard rock forms the control for the outflow of the lake. From this point on to Lake St. Francis below Cornwall; the fall is everywhere appreciable, with steep pitches at the Rapide Plat, Farran's Point and Long Sault. The whole fall from Lake Ontario to Lake St. Francis is ninety-two feet. Just opposite Cornwall the International boundary enters the river from the south, and a few miles further east the Interprovincial boundary enters Lake St. Francis from the north. Thus, above Cornwall the river is an international stream, while below Cornwall the power reaches are entirely within the Province of Quebec. The Province of Ontario, is thus interested, so far as power development is concerned, in this International reach.

Two general schemes of power development are worthy of consideration. The first of these involves the construction of dams and power houses in the vicinity of the Long Sault Rapids, whereby all of the available fall in the International reach of the river would be used at one point. Of the whole fall from Lake Ontario to Lake St. Francis, the part available for power varies according to different engineers or organizations, that have reported upon schemes, from 70 feet to 82 feet. The remainder is used in surface slope of the river or at control dams.

One of these schemes is known as Scheme "A" in the Hydro report. In this scheme it is proposed to build a control dam in three sections from the Canadian to the American shores, about two miles upstream from Morrisburg. By this means, variations in discharge and Lake Ontario level can be effected without change in the headwater elevation at the power house. The main dam is located in the Long Sault Rapids joining the eastern end of Long Sault Island with the western end of Barnhart Island. A second dam at the head of Long Sault Island closes the South Sault Channel, and the closure of the channels is completed by a concrete dam backed by an earth fill extending from the north end of the power houses, which are at the east end of Barnhart Island, to the high ground near the centre of Sheek Island. Navigation structures control the channel north of Sheek Island. The channel between Sheek Island and Barnhart Island will serve as the power canal leading to the forebay to be excavated

at the east end of Barnhart Island. Two power houses are proposed, forming a broad "V" in plan, with ice sluices between them. These will house fifty-two units developing 34,000 horsepower each under a head of 74.5 feet. The rated capacity of the plant is 1,500,000 horsepower. The headwater elevation in the forebay will be 231. (Lake Ontario has a mean elevation of 246.5). Structures are designed so that the headwater elevation may be increased at some future time if it is feasible to do so. Over 11,000 acres will be subject to damage by flooding, which will be increased to 29,000 in the event of the headwater elevation being increased to 240, which is a possibility.

The second general scheme divides the head to be developed into two parts, making a so-called two-stage development. Schemes "B" and "C", of the Hydro report, belong to this general scheme. They differ from each other in the location of the upper power house, which is at Morrisburg in Scheme "B", and at Crysler Island, four and one-half miles downstream from Morrisburg, in Scheme "C". Below Crysler Island these two schemes are identical,—a second power house and dam being projected at Barnhart Island as in Scheme "A", but under a lower head, viz., 54.5 feet. The profile of the river after development is shown in Figure 1.

Somewhat more attention has been paid to Scheme "B" of late,

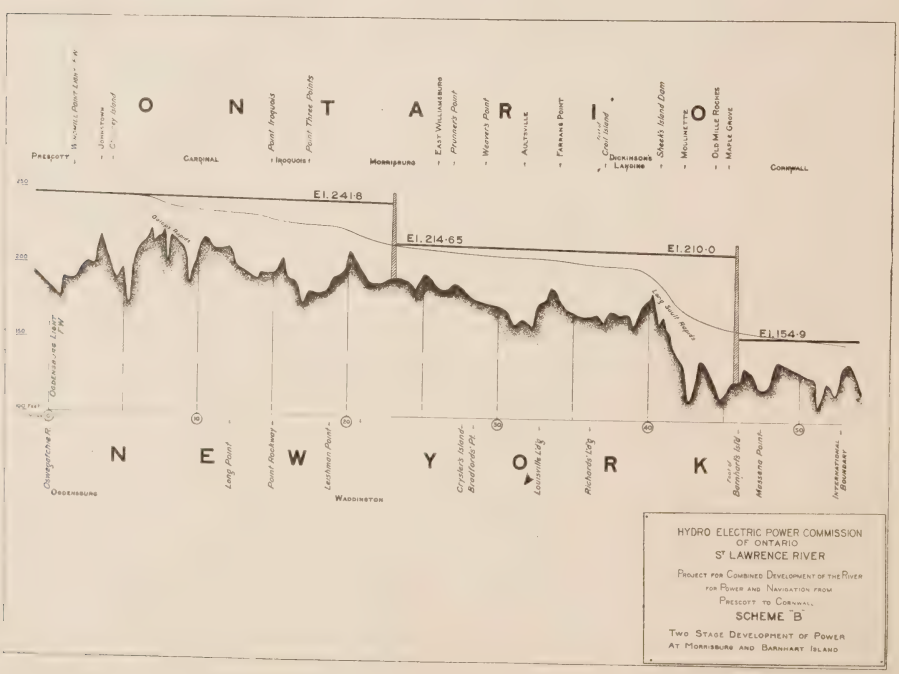


Fig. 1. Profile of St. Lawrence River after Development, Scheme B.

Fig. 2. Power Houses and Dam, Upper Development, Scheme B.

on account of some of the advantages it possesses, as, for example, the rapidity with which it could be carried to the producing stage.

The first stage of this development would consist of the structures in the vicinity of Morrisburg. (A map of the locality with these structures marked thereon, is shown in Figure 2). The main channel of the river will be blocked by a dam extending from the Canadian shore, about one mile above Morrisburg, to Ogden Island. Facing Morrisburg will be a Canadian and an American power house, the former extending across the channel from Murphy Point to Clark Island, and the latter from Clark Island to Ogden Island. The channel between Ogden Island and the American shore, known as Little River, forms the channel leading to the forebay of the two power houses.

The power houses will operate normally under a head of 27 feet and, according to the preliminary designs, will contain sixty-five units with a capacity of 10,800 horsepower each. Recent developments in turbine design may warrant the use of a smaller number of units of greater capacity than these.

The velocities in the river from the head of the Galops Rapids to Morrisburg, and in fact to the lower development at Barnhart Island in Scheme "B", will be so great as to prevent an ice cover forming. The run of ice in the river under these conditions will follow the south shore when a north wind is blowing, and vice versa. To dispose of this ice, special sluices are provided at the north end of the dam in the main channel, and in an excavated channel south-east of the American

Fig. 3. Power Houses and Dam, Lower Development, Scheme B.

power house at Murphy Point.

The lower development in Scheme "B" is quite similar, as to location of structures, to Scheme "A", but the headwater level is at elevation 210 at Barnhart Island. Figure 3 is a map of the river in the vicinity of the Long Sault Rapids, and shows the location of main dam, power house, etc., in Scheme "B".

The two power houses will contain fifty units, each with a rated capacity of 25,000 horsepower under a head of 54.5 feet. Together with the power house at Morrisburg, the rated capacity of the plant will be 1,600,000 horsepower. The installed capacity of course exceeds this. About 6,000 acres will be damaged by flooding.

The construction of the dams at Morrisburg will necessitate the substitution of an artificial system of control of lake levels and discharge for the natural system provided by the crest of the Galops Rapids. Various systems of regulation have been investigated and, basing conclusions upon the effect of these when applied to the actual outflow of the lake, month by month since 1860, it will be possible to increase the minimum lake level and outflow, decrease the maximum and improve navigation levels appreciably downstream from Lake St. Francis during the low water Fall months.

Industrial Electric Heating for the Central Stations and Manufacturers

By Wirt S. Scott, Manager, Industrial Heating Section, Westinghouse Electric and Manufacturing Company, East Pittsburg, Pa.

THE advance of civilization depends upon the art of heating. Notwithstanding this, the art of heating has not kept pace with other developments, which reasons are apparent.

Until within the past 7 or 8 years, fuel, labor and materials were cheap. Inefficiency in operation was tolerated since losses resulting as such, were of secondary consideration. Efficiency in ovens and furnaces was practically an unknown quality, due to the low fuel costs. Ovens and furnaces were designed and built by the *user* without any knowledge of what to expect in the way of heat losses. Manufacturers could afford to pay for labor to watch the ovens or furnaces, to handle rejected or spoiled materials, or to carry or truck material around, in and out of the ovens or furnaces by hand. Materials were so cheap that in case it were improperly heat treated, it could be reheat-treated or perhaps entirely discarded without a great loss.

Fuel, regardless of its character, can no longer be wastefully used, as in the past, and industrial plants are becoming educated to the use of better construction in ovens and furnaces. This condition makes it increasingly easy to sell electric heating appartus, which due to the fact that the fundamental cost is high, must be designed and built to conserve energy necessitating a more expensive construction.

The high price of labor demands that each manufacturing plant employ the minimum amount of labor to maintain a given production. By means of electric heat and automatic temperature control, supplemented where permissible by conveyors, the labor required for a given production can be reduced materially over that required by other forms of heating.

The increased cost of materials makes it essential that there not only be no rejects, but that materials relatively low in cost be so fabricated that when completed they will be so improved in quality that they will take the place of a higher grade of raw material formerly used.

And on the top of all this, there is the inevitable ultimate demand for a uniform high grade quality product. There is even now a demand for quality instead of quantity where weight is a detriment or does not add any desirable characteristics, and where reduced weight would be a decided advantage, provided a smaller cross section could be used having the same tensile strength.

The use of electric heat permits of the conservation of energy, the saving of labor, and the production of a high grade, uniform quality pro-

duct in a manner unattainable by any other form of heating.

The first consideration, and one of the most vital importance to a prospective customer, is "what does it cost to operate"? It is true that the cost of power may influence, but certainly does not determine the cost of the complete product.

The cost of the completed product, and the quality of the product, regardless of apparatus or power costs, is the real measure of value of electric heating, and is the determining factor. The extent to which this end is attained will depend upon the investigator, his knowledge of the equipment available, his knowledge of the fundamentals of heating, his knowledge of the particular industry and application in question, his ability to size up each proposition and determine just how great an expenditure of money the manufacturer can afford to spend in improvements.

INDUSTRIAL electric heating at the present date compares favorably in status to the electric motor twenty years ago, both as to connected load and apparatus available. In the application of electric motors to factories, the reasons advanced to justify their use, based upon experience or knowledge of installations made in the past, are, continuity of service, reduced maintenance, ease of operation, and increased production. In some cases, a reduction in power costs can be shown, and in others, a better product due to the ability of the motor to maintain a constant speed. It is a well established fact that, regardless of the application, the electric motor can show a lower yearly operating cost than any other form of power, and no one at the present date would seriously consider equipping machines with steam or gas engines where central station power is available.

However, the electric motor required twenty-five years to reach its present growth, and not without a great amount of pioneer investigation and development work. Thus far, approximately an equal amount of energy and effort on the part of the central stations and electrical manufacturers has been required in the developments of industrial electric heating.

Considerable attention has been given to the electrification of enameling ovens in the automotive industry, the result of concentration of effort and thoroughness of investigating in a field offering no particular advantages except a willingness to co-operate. Since then a sufficient number of greatly diversified installations have been made, in many sections of the country, with companies having world wide reputations, to demonstrate conclusively that electric heat, properly applied, results in increased production, better quality of product and lower operating costs.

As a general statement, electric heat is fundamentally the ideal heat, and it is commercially economical. Some applications at the present time would appear to offer no particular advantage, but such also was the case with the electric motor in its earlier development. New developments in the methods of manufacture will solve

the more difficult problems, and probably at some future date make the use of electric heat absolutely essential to the success of such installations.

The value of electric heating to a manufacturer may be summed up into three sentences:

Uniform, High grade quality of product.

Reduced expenditure for labor.

Better working conditions.

1. Heating units, in suitable form, may be distributed in an oven or furnace, attached to a tank, table or machine, in a correct manner to give a uniform distribution of heat, in just the quantity desired. Once these conditions are secured, they become fixed for all time, and are not subject to change or variation as with gas or oil. This condition results in a better product, increased production, and increased output per unit of floor space or for each piece of apparatus.

2. By means of automatic temperature control, the work will not be overheated or underheated, but maintained at the correct temperatture, continuously and automatically. This eliminates entirely the human element, and the resultant loss, due to the impracticability of controlling the heat generated from combustion fuels to the same degree with which it can be controlled when using electric heat.

3. By means of electric heat, automatically controlled, tests can be made to determine the proper rate of heating, the best temperature for accomplishing the desired results, and the length of time the work must be subjected to a given temperature, to produce the desired results. Once these conditions are determined, the desired product can be reproduced day by day, automatically, with the same uniform results. Electric heating has made possible the duplication of laboratory experiments in shop practice.

4. The air in electric ovens or furnaces is not contaminated by products of combustion. In fuel fired ovens, carbon, one of the products of combustion, settles on the work, and in cases where a protective coating, requiring a high gloss is being baked on the work, or in the baking of food stuffs, the surface will be covered with microscopic deposits of carbon. The color will also be dulled by the effect of the gas fumes.

In fuel fired furnaces, it is necessary to force a large quantity of air into the furnace, under pressure, in order to support combustion, and at the same time secure the greatest heating effect from the flames. Materials at high temperature oxidize very readily when allowed to come in contact with air, therefore, the oxidation in such cases is greatly increased. In an attempt to overcome this objectionable feature of a fuel furnace, some shops have adopted the practice of using what is termed a reducing flame, or a flame produced by an insufficient amount of air, at the expense of imperfect combustion. Research investigations have shown, however, that the major oxidation is not caused by the air in the furnace, but by the moisture formed as one of the products of combustion. This

moisture is in the form of superheated steam at high temperature, and attacks metals at high temperature very violently, resulting in scale.

5. Electric heat may be used to advantage in connection with all kinds of automatic continuous conveyor ovens and furnaces. Conveyor type ovens were made possible by the use of electric heat, and many types now in use would be impracticable if heated by other means. Continuous conveyor equipment together with automatic control has made possible a great reduction in labor.

Low and medium temperature electric heating equipments, when properly applied, have an indefinite life, the maintenance being much less than gas or oil equipment for performing the same operation. The maintenance on high temperature furnaces should not be 25 per cent. of the maintenance on fuel furnaces. The higher the temperature of operation, the higher the maintenance becomes with a fuel fired furnace, due to the fact that a high temperature head or gradient must be obtained in order to force the heat into the chamber with a reasonable speed of production, and the higher the chamber temperature, the higher the combustion temperature, with the result that the linings are soon burned out. This is a large item of expense.

6. Fuel furnaces either burn the gasses directly in the heating chamber, or in a separate combustion chamber. When burned in the heating chamber of the furnace, the heat is intensely localized, and much overheating and spoiling of the work results. Also, the effect of oxidization is ruinous. When burned in a separate combustion chamber, the furnace is built with a hollow space surrounding the furnace chamber on sides and top (muffle type), the hot gases passing through the space between the outer and inner walls, heating the furnace chamber and work by conduction of heat through the fire brick. In order to do this, and maintain a reasonable speed of production, the inside walls of the hollow space must be at a temperature approximately 50 per cent. higher than the furnace temperature with the result that the fire brick lining soon disintegrates or melts down, causing a shut down for repairs. In addition to the cost of repairs, the furnace is out of operation for several days, periodically.

With electric furnaces, the heat is generated within the furnace chamber, and since it is uniformly distributed, the temperature of the heating element will at no time be much higher than the furnace chamber temperature, hence the life of the brick work should be indefinite. Not requiring air for combustion, the amount of air within the furnace is greatly reduced, the work coming out of the furnace with less scale. Special furnaces can be made in which the air is eliminated entirely if such a course is necessary for some special product.

Fuel furnaces of the muffle type do not prevent the products of combustion from entering the furnace chamber except when the muffle linings are new. The lining is soon distorted by heat, the cement between

the bricks burned out, and within a short time the gases have free access to the furnace chamber.

No practical means have been devised for the heating of the floor or hearth of a fuel fired furnace to any appreciable extent. This is due to the fact that the hearth must support the charge in addition to its own weight, consequently it must be of heavy construction, and usually so thick that it is impractical to attempt to force heat through it. With electric furnaces, the hearth can be heated ideally, by placing heating units in the floor.

Fuel fired furnaces, due to these limitations, as to design and construction, cannot heat the furnace chamber, and consequently the work, as uniformly as an electric furnace. Since the total length of time required for heating a charge is dependent upon the time required to heat the coldest portion up to the required temperature, the heating period or length of time required, is that time required to bring the entire charge up to the required temperature. With an electric furnace, the furnace can be designed for heating the specific material uniformly, in the minimum length of time by properly locating the heating elements within the furnace chamber, so as to produce the desired results.

The floor of a fuel furnace is always the hardest and last place in the chamber to be heated, the heat reaching that part practically by conduction only, since in most cases, the hearth will be covered with the work, and the greater part of the radiant heat is stopped by the work. The hearth, in this case, not being a source of heat, but having been heated previously while the furnace was empty, gives up a large portion of its heat to the cold charge, cooling the floor materially, with no means for restoring its heat, except by conduction through the charge.

The charge will not be uniformly heated until the bottom portion is heated, and the bottom will not be heated until the hearth has been heated, consequently, you will hear used the term "soaking period," in connection with fuel furnaces, which correctly means, the length of time required for the heat to penetrate to the coldest portion of the work, after the pyrometer couple, usually located somewhere near the top of the furnace chamber, has reached the maximum temperature.

Assuming a given condition; with a given furnace brought up and maintained at a given temperature (furnace empty); a sufficient length of time to assume a uniform temperature throughout the entire furnace chamber the length of time required for heating a charge of a definite material, of a definite weight, and for a definite temperature rise will depend upon two things, *i.e.*, the relation of the mass of the material to its surface, and the ability of the furnace to radiate heat uniformly and continuously to the surface of the charge. A cannon ball, having the least area for a given mass, will require a maximum length of time for heating. For the same mass, the greater the area, the more rapidly it

will absorb heat, and if the material be rolled into thin sheets, the rate of absorption, and consequently the rate of heating will be tremendously increased. The heating of a charge in a furnace should be done by radiant heat, which travels the same as light. The more surface in a furnace, generating and transmitting radiant energy, the quicker and more uniform the work will be heated. In an electric furnace, radiant heat is generated and radiated uniformly from the sides, top and bottom (in special cases, heating units may be placed in the rear wall and door) so that all exposed surfaces of the work receive a maximum amount of radiant energy, consequently the time required for uniformly heating a charge is materially less than for a fuel fired furnace of the same size.

It is becoming recognized by authorities on heat treatment that in order to produce the highest grade quality product, regardless of the nature of the material, that the following rules must be observed:

1. For every kind of material or product, there is some best rate of heating from the initial to the maximum temperature.

2. For every kind of material or product, there is some best maximum temperature which it should be heated.

3. For every kind of material or product, there is some best rate of cooling from the maximum temperature down to room temperature or some lower temperature.

4. That in order to obtain the conditions as above outlined, an oven or furnace must be capable of heating its charge uniformly and at a definite rate to a predetermined maximum temperature, held at that temperature for whatever length of time required, and permit the charge to be cooled at a prescribed rate.

5. The electric oven or furnace will accomplish these results in an ideal manner, and furthermore, they are the only kind that will.

Statistics gathered from different sections of the country show that the revenue produced by one kilowatt connected of industrial heating load, is on an average twice the revenue of one kilowatt connected of the motor load. This shows very clearly the value of such a load to the Central Stations. If this statement is true in general, there is the possibility of doubling the present revenue with an increase of plant equipment of only 50 per cent.

Central Stations having surplus plant capacity available will find it profitable to investigate the possibilities for industrial heating in the territory they serve, and to place themselves in a position to secure and service such a load. To promote this business, the power engineers must have a good understanding, of the problems and applications arising from his surveys or investigations, a knowledge of the apparatus available and the ability to advise the customer in such a manner as to reflect credit upon the Central Station.

Years ago, one was apt to regard domestic heating as a luxury, and something altogether too expensive for the person of average means.

To-day it is recognized for what it is worth in the home, and as such the cost of operating is not an influencing factor with a person purchasing a flat iron or perculator. The Central Stations too have recognized the desirability of the domestic heating load, and are spending annually vast sums to get these appliances on their lines.

Since the Central Stations are convinced that the domestic appliances are a profitable load and worthy of all the great amount of effort put into the sales of such devices, it may be permissible to accentuate the relative importance of industrial heating by showing a comparison of energy consumption and dollar value between several heating devices and an industrial space heater.

Comparative Energy Consumed and Revenue based on the Same Value of Apparatus:

1—500 watt flat iron sells for $7.00. Consumes 60 kw-hr. per annum. Yearly revenue at 1½c per kw-hr.—90c.

2—500 watt space heaters sell for $7.00. Consumes 2400 kw-hr. per annum. Yearly revenue at 1c per kw-hr.—$24.00.

Space heaters consume 40 times as much current and produce 26.6 times the revenue.

1—500 watt toaster sells for $7.00. Consumes 36 kw-hr. per annum. Yearly revenue at 1½c per kw-hr.—54.

2—500 watt space heaters sell for $7.00. Consumes 2400 kw-hr. per annum. Yearly revenue at 1c per kw-hr.—$24.00.

Space heaters consume 66.6 times as much current and produces 44½ times the revenue.

1—One thirtieth horsepower sewing machine motor sells for $24.00. Consumes 15 kw-hr. per annum. Yearly revenue at 1½c per kw-hr.—22½c.

7—500 watt space heaters sell at $24.50. Consumes 8400 kw-hr. per annum. Yearly revenue at 1c per kw-hr.—$84.00.

Space heaters consume 560 times as much current and produce 374 times the revenue.

1—Wash machine sells for $150.00. Consumes 30 kw-hr. per annum. Yearly revenue at 1½c per kw-hr.—45c.

43—500 watt space heaters sell for $150.50. Consumes 51.600 kw-hr. per annum. Yearly revenue at 1c per kw-hr.—$516.00.

Space heaters consume 1720 times as much current and produce 1146.6 times the revenue.

The above data is submitted in an attempt to show the value of this tremendous potential load to Central Stations, and to prove that a national development of the Industrial Electric Heating Load will justify and warrant an expenditure of money at least equal to that now being expended in connection with securing the motor or appliance load.

Discussion

Mr. W. R. Catton, Brantford: I would like to ask Mr. Scott if he knows of any attempt made to electrify the present bake oven, that is, a coal fired oven as used by the bakers now.

Mr. Scott: No, we haven't made any attempt, because those ovens are not insulated. The cost of operation would be excessive and it would not be satisfactory. In order to use electricity economically, due to the fact that the cost of heat is relatively high you must conserve the energy as much as possible. The old baker's oven has a bunch of brick not insulated at all, and you will find that the radiation loss would be probably three or four times what it should be, and the consumption per pound of bread would probably be double what it is with a well insulated oven, so that it would pay a baker to junk his present oven. As a matter of fact, I know of a case that came to my attention where an oven had been in operation for some years and was torn down, and in excavating they found the earth was heated to a point 25 feet below the oven.

Mr. H. O. Fisk, Peterboro: You mentioned the fact it took 100 watts per pound.

Mr. Scott: 100 watt hours.

Mr. E. V. Buchanan, London: At any other time than this the paper would have been very welcome. It is a curious thing that we should have a paper of this kind just while the Rate Committee is meeting and wrestling with the problem of adjusting rates so as to prevent the wastage of current.

However, there is the possibility that we can still develop a considerable heating load under present conditions if we will put the customers on entirely restricted hours. That is what we have tried to do in London and have met with some success. We have restricted the industrial heating load between 11.20 and 12 o'clock, and between 5 and 6 in the wintertime, so that for our local conditions at any rate, at the present time, it cuts the industrial heating load entirely off our peak, and we find that most of the manufacturers can comply with these conditions.

One of the main reasons why this load has not been developed more in the past is that nobody seemed to know anything about it. And it was all right to say that there were a great many applications, but in our enthusiasm we would go out and interview a manufacturer, then go away to find out where we could get some device to do the job and there wasn't any.

I think it is hardly fair to make the comparison in the paper between the cost of a space heater and the cost of a washing machine. After all, it is very easy to sell a washing machine, but it is very difficult to sell a space heater, have it completely installed and ready for use. With the washing machine the $150 covers a great deal more than the electrical element, while in the space heater you are only selling an electrical element and not the complete device for doing the job.

Industrial electric heating applications have to be treated each on its merits. I do not think that any of us are really competent to go out and try

and sell these applications. You have to have an expert who knows the job to go and do it, and, from my own experience we have tried to steer clear of it for some time. Fortunately, it may be unfortunately for us, we have in our town a manufacturer of industrial electric heating appliances and he is doing the work for us. My point is that the industrial electric heating appliances cannot be adopted universally.

There have been a number of failures in the past on industrial heating applications, and failures always set back a movement very much. One of these has been that the elements failed and were not easily renewable.

In some of the higher temperature processes, at least, it takes some time for the oven to come to the required temperature, and it takes just as long for it to cool down, and if you have a failure of an element and it is going to take a day or two for the oven to cool down sufficient to allow a man to go into the oven to remove that element, it is a serious drawback to the manufacturer, and that has been the drawback in some of the older applications that I know of.

On the other hand, there is no doubt that there are a great many advantages. I think Mr. Scott has mentioned most of them. Quality of the product, of course, is the big factor. Control of the atmospheric conditions in the oven, the freedom from dust and gases, and so on,—as one of our local manufacturers put it: "What I like about electric heat is that it is heat and heat only", and he was comparing it with gas.

Another good point is fire protection. There is much less danger from fire with electrical ovens and furnaces than with any other kind. Another point is the grading of the temperature. There are cases where you want a high temperature at the front of the oven and a low temperature at the back, and that is very easily obtained electrically and is not easily obtained by any other process.

Perhaps you would like to hear just what one or two of our manufacturers say about the appliances they have. At one of the factories they have a vitreous enamelling oven. They say that the cost of current, and it runs around somewhere between 1 cent per kilowatt hour, is 80 per cent. of the cost of oil at the present time. The maintenance, so far, has been about 10 percent. of the maintenance of an oil furnace, and the first cost of this furnace was practically the same in this case, and it looks as if the life would be much longer. Another example, one of the higher temperature processes, that is in the melting of brass. A brass company in London has several brass furnaces. They figure out that the cost would be about $4.34 per ton for electricity. Oil costs, at present day prices, about $4.50 per ton. The repairs on the brass furnaces were very low. They say it has cost up to date about 30 cents per ton of output. The quality of the product is much better, more uniform; they say there is a big saving in material, there being no loss by oxidation.

Another point that may be of interest to us is that in none of the applications we have, have the interruptions to service disturbed the manufacturer at all. In one case the brass company had an interruption, and the furnace froze up

but was melted out without any damage to it.

We have also in a biscuit factory several biscuit ovens, taking about 120 kilowatts each the output being 3½ tons of biscuits per 9-hour day. They have saved there, in addition to the somewhat less cost of electricity as compared with coal, the labour of one man stoking three ovens and one man removing the ashes from seven. A point is made that the biscuits produced are better; the flavour is better and the biscuits are much cleaner. In the old type of oven, smoke would enter it and cause some discoloration. Their maintenance problems in this particular instance, so far, have been bad, but they say, with new elements they anticipate an improvement. With the coal ovens they had to blow in tremendous quantities of steam to retain the moisture in the biscuits; with the electric oven they do not have to do that at all giving another financial saving. When they were using a travelling biscuit oven, heated by coal, and an interruption occurred the motor-driven conveyer stopped and the biscuits were burned up. Now when the power goes off the heat goes off also and there is no damage done. They can also change rapidly from one temperature to another, which could not be done with the other type of oven.

We have another manufacturer who carries on his motor load during the day, and without increasing his peak at all, he does his japanning during the night. He says here:

> "We have been using Hydro power to heat a japanning oven for several years past and with uniformly satisfactory results. We prefer Hydro to gas for this purpose because we do not have to reckon on the products of combustion which sometimes interfere with best results in japanning according to our experience.
>
> In our case Hydro is particularly desirable because we use in our oven at night the same run of power that we use in the factory in the daytime. We load up two or three racks and the watchman slips them in and out of the oven. In the morning our material is all dry and ready to pack. The cost of operating an oven in this way is less than any other method we know of.
>
> We are also using Hydro power in a case-hardening furnace very satisfactorily.
>
> Another application of Hydro is in a small furnace for tempering dies which we consider very much superior to a gas furnace. We can work more accurately and our results are not complicated by variations from day to day in pressure or composition of gas."

We also have a core treating oven in use; also we have quite a number of confectioners, bakers, etc., who speak very favorably of the operation of the electric oven, emphasizing that point again about the moisture in the product which means quite a little.

Mr. Scott: There was one point Mr. Buchanan mentioned about the shutting down of furnaces if an element was burned out. It is true that that might happen. It happened before certain changes were made in construction of elements, but furnaces built these days have a suffi-

cient number of elements in the furnace so that if one element burns out a jumper can be placed around that element on the outside of the furnace. In one furnace in particular where we had 36 elements in the furnace, the terminals of which came through the sides of the furnace, we had four elements connected in series across 220 volts. Now, one of those elements burned out. Of course, as soon as it went, the other three elements also went, but the workmen noted immediately that there was a certain section of the furnace that was dark. The company had a spare element on hand and it was jumped in on the outside across where the element was burned out, completing the circuit with three elements inside and one on the outside, so the furnace was operating with 35 elements for four months' time before it was shut down. The furnace was out of operation just one half hour's time.

Mr. Buchanan: Why not make the furnace with elements removable from the outside?

Mr. Scott: That is very very difficult. It can be done. The Ford Motor Company in Detroit practically demand that kind of equipment, because they claim that they cannot stand for a shutdown at all. As I say, it can be done but at the sacrifice of efficiency. The Ford Company say they have to go right ahead, and they are willing to sacrifice efficiency for continuity of operation. There the elements are made removable and can be pulled out, but such furnaces cannot be made as efficient as the other type.

Mr. M. J. McHenry, Walkerville: The question of electrical heating at the present time may not seem to appeal to our particular Association as much as it might if we had more secure assurance of continuity of power supply. Unfortunately, we have heard so much within the last month or two months of the fact that in 1926 we will have no further surplus power, so that the question of obtaining additional loads on our systems is one that apparently does not interest any of us at the present time. This is a rather unfortunate situation when we call to mind the number of applications that can be made of electricity for heating in industry.

There are, however, several applications that I think a great number of municipalities can still make even with the fact facing them that the surplus of power will shortly be used up. We happen to have on our system two installations where the power used for industrial heating is entirely off peak. One is a plant manufacturing all sorts of lamps for automobiles. During the daytime they have, approximately a 150 h.p. motor load, and at night they have a load of approximately the same capacity in enamelling ovens, giving practically a 90 percent. load factor. They are obtaining their power for about nine-tenths of a cent per kilowatt hour, and giving us a very nice load on our system.

We have a second plant manufacturing automobile windshields. They do the same thing baking the enamel on the frames in electric ovens at night. Applications such as those, I think, could still be made by a great many of the municipalities and could be made on a very equitable basis with the ques-

tion of lack of power facing them as it does to-day.

There is one point which, I think, Mr. Scott's paper has brought out, and which should be considered when any attempt is made to obtain a load of this type, and that is the fact that the saving which can be effected by using electricity is not necessarily in the cost of the energy supplied to obtain the heat. There are a number of installations where, I think, possibly the cost of energy supplied is as great, possibly greater than the cost of oil or coal, or whatever fuel was used before, but the saving that has been effected has been in labour, in material required, and in the quality of the product, and those points should be considered in every application of electricity to heating problems.

In most cases I think it will be found, as Mr. Scott very ably illustrated in his paper, that the saving in labour will be a very big item, and each situation that arises, where the question of installing electricity is being considered, should be analyzed from every aspect, and I think that, in the majority of cases, it will be possible to show the consumer that electricity can be used to better advantage than almost any other type of energy that can be obtained to-day.

Mr. M. P. Whelen, Toronto: I would like to ask Mr. Scott a couple of questions. We have a proposition in Toronto of a core baking oven, where coke is selling at about $13 a ton. Can you give us any idea as to what rate per kilowatt hour electricity should be to compete successfully in that case? It is rather a small-sized installation.

The second question is: In speaking of enamelling ovens, is it necessary now to protect the heating elements to avoid danger from explosion in enamelling ovens?

Mr. Scott: You cannot say off-hand just what the cost will be in comparison to coke at $13 a ton, it would be quite difficult to do that. I might make a comparison in another way. I know of one case. They were using coke, I think the coke was $8 a ton and the electricity was 2 cents a kilowatt hour, and, for that particular type of oven, the cost of the electricity was two and a half times the coke bill, but the saving effected was in eliminating the amount of rejects that they had. Now, those particular figures with the same power bill and the same cost of coke would vary with some other oven, or some other particular kind of core that they are baking, so it is pretty hard to draw a conclusion from that.

You might get at it this way: You take a small core that will weigh say, from 3 to 4 pounds, or 5 pounds, and with a truck type oven where the cores are loaded on the truck and run into the oven without losing much heat, you ought to be able to get 10 pounds of core per kilowatt hour, with a well constructed oven. Usually the smaller the core the better saving you can show, particularly with reference to the rejects. I would figure roughly, say from 8 to 10 pounds of cores per kilowatt hour.

The other question about explosions and protection of the heaters: It isn't necessary to protect the heaters from explosions; you cannot design a heater which will eliminate an explosion irrespective of how you make it. It is

purely a question of having a sufficient amount of ventilation in the oven to carry off the fumes as they are produced. In enamelling, naphtha is used, maybe gasoline or kerosene, or any of those derivatives. All it does is to thin the enamel so that it can be applied smoothly, and in the baking process all of that naphtha is driven out again. Now, you get the same condition there that you get in the operation of a gas engine; you have an explosive mixture. If you have a rich mixture you do not get as much of an explosion as you do if you have just the right mixture. If you have a lean mixture your explosion is reduced. Assuming that it would be possible to have such a rich mixture that you could not get an explosion you wouldn't have sufficient air in there to oxidize the enamel, and therefore, it wouldn't get hard. You must have a certain amount of air in there to oxidize the linseed oil. From tests we have made a safe value to prevent an explosion in an oven is 95 percent. air to 5 percent. volatiles by weight, given off.

Mr. R. H. Starr, Orillia: Some years ago, a manufacturing manager of one of the woodworking plants in Orillia approached both the C.G.E. and Westinghouse in connection with an oven for baking enamel. He got no reply other than to say that there was nothing on the market at that time He therefore went to work and built an oven, making the heating element of ordinary knobs and stovepipe wire, and it worked very well. This man is at present with a chemical company that treats about 90 cords of wood per day, making it into charcoal. He wants to know what it will cost to do that electrically instead of by coal.

Mr. J. A. Harris, Toronto: I would like to revert back to a remark made by Mr. Buchanan, that it is possible in London to use the industrial heating load during restricted hours. It would be rather interesting to know just how he handles that situation, as far as the metering and the billing of that off-peak condition, taking into consideration the possibilities of the load being taken from the same source of power as the motor power.

Mr. Buchanan: Separate graphic meters are installed on the heating devices and they are treated as a separate contract altogether.

Mr. H. F. Shearer, Welland: I would like to ask Mr Scott if it is characteristic of all stationary type of electric ovens that the initial temperature will increase as the use of the oven proceeds. We had a little experience in Welland this last fall, a 240-loaf 3-deck type oven, and we found that the first batch of bread would drop the initial temperature very considerably, but as the succeeding batches went through there was less effect on the temperature of the oven.

Mr. Scott: Yes. That is characteristic of any kind of oven, whether electrically heated, or gas, or anything else, because, to start up with the material of which the oven is made contains no heat, and when you first start up you have to drive heat into this material. At first you may start up the oven and run it for one hour's time before you reach 400 degrees fahrenheit. Well, during that period while the oven goes up to 400 degrees fahrenheit in the

course of an hour's time the heat has only penetrated the oven material to say one inch, in a total of four inches. Then you put in your batch of bread in the oven. In addition to drawing the heat from the heaters you extract the heat from the sides of the oven for a certain period, for maybe 10 or 15 minutes. Every time you put in a batch you extract a certain amount of heat out of the insulation but you keep putting more in all the time, so that at the end of say, 6 or 8 hours' time the oven is completely saturated, then you don't have to put any more heat back into the oven. The more heat you have to put back into the oven the less heat you have available to put into the bread.

Mr. C. E. Kirkby, Brantford Twp.: I would like to ask Mr. Scott whether he knows of any successful ovens that are operating on 550 volts of about 10 or 15 kilowatt capacity, also if he knows of any installations of electric peanut roasting machines where the peanuts are afterwards used for making peanut butter.

Mr. Scott: We have 246 in operation on 600 volts, D.C. street railway work.
There is no reason why it cannot be done on 550 volts A.C. but there hasn't been a demand for it.

Mr. Buchanan: There are several 550 volt A.C. installations in London.

Mr. Kirby: The man I have in mind has tried this out, and instructs me that they cook the peanuts rather than roast them.

Mr. Scott: A gentleman was asking something about an application for charcoal manufacture. I do not know of any place where they are doing that electrically, neither would it be very easy to determine the amount of power required.

Mr. Harris: I would like to ask Mr. Scott if he knows of any applications over here or in the States where they are using the conveyor type of ovens for lithographing on tinplate.

Mr. Scott: We put in six ovens for the lithographing of metal signs, and also doing a certain amount of metal bottle stoppers, and things like that, lithographing on sheets of tin about 28 in. x 30 in. Those ovens have been in operation continuously for the last 5 years. Formerly, they had an oven of that same size heated by means of steam, and it took them three hours' time to get a bake, using only two-thirds of the truck. The lower part they couldn't use at all. With the electrical equipment they are getting a bake out in 25 minutes, and using the entire depth of the truck. The six ovens they have now, are taking the place of about an acre of gas heated ovens, and they are very successful.

Mr. Pratt, Cataract Power Co., Hamilton: We have in Hamilton on our 60-cycle service one very noticeable electrical heating installation of the Arc type, three furnaces taking about 400 kilowatts each. This man has a little attachment that notifies the Superintendent, by ringing a bell, when the demand exceeds a pre-determined amount, giving a desirable load curve.

We also have one customer using a brass furnace. When he put it in he was rather disappointed at the amount of current it took, but since then we have had no complaints. He is using, I should say, about 20,000 kilowatt

hours per month, paying approximately, 1 cent a kw-hr.

We also have one large manufacturer using our service for galvanizing, annealing and enamelling wire. Our friends in Hamilton have also a large customer using the service for galvanizing shields.

Mr. Pease, Hamilton: We have used electric heat for galvanizing, and find we consume 10 kw-hr. per ton of wire. We do not consider the cost of the current at all on account of the uniformity of the product. We also use electricity for annealing, and anneal wire at 10 kilowatts per 100 lbs. with a temperature of 1,450 degrees.

Mr. Miller, Hamilton: What I am particularly interested in is the galvanizing furnace. We have not been very successful so far, from a financial standpoint, or improvement in quality. We find that there is no difference between the oil furnace and the electric furnace in the quality. What we are interested in is getting down the cost. Our heating engineer told us that this particular furnace which heats 29 tons of galvanizing could be operated at 125 to 150 kilowatts. We tried it out at that, and also at 175, and, at the present time, we are trying it at 225 kilowatts which, I believe, will be sufficient heat. But the cost is a great deal over that of oil.

Mr. Scott: Galvanizing is one of the subjects that we have classified as coming under the undesirable group, not from the ability of the manufacturer to supply equipment because it is not a difficult application to make, but from the difficulty of showing the manufacturer that it is worth while.

Bingham Chutes Development

By T. C. JAMES

Assistant Engineer, H.E.P.C. of Ont.

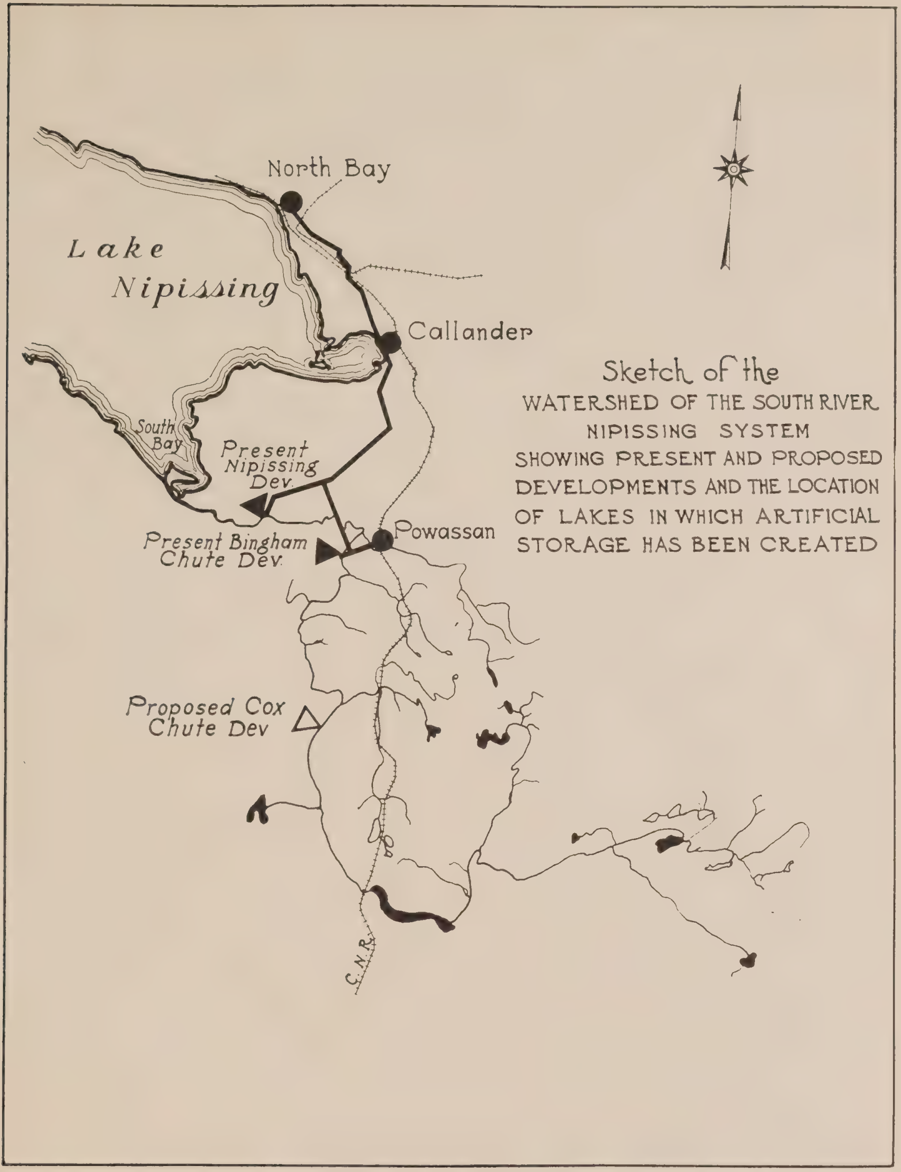
THE development of Bingham Chutes on the South River was undertaken by the Commission to secure additional generating capacity for the Nipissing System, the original development at Nipissing on the same stream being inadequate to supply the existing demands, which have increased by over 100% during the eight year period in which this system has been operated and administered by the Commission.

When the Nipissing System was acquired by the Province in 1916 along with the other properties of the Central Ontario system, the source of supply consisted of an hydraulic development of 900 kw. capacity near Nipissing on the South River, comprising two 450 kw. units and a bank of three 300 kw. transformers, supplemented by a steam plant at North Bay for use during low water periods, North Bay, Callander and Powassan being the three municipalities receiving service. The steam plant was old and

very inefficient to operate, having completely outlived its useful life. As the South River is subject to periods of extremely low flow, it was found necessary to make use of the steam plant on various occasions for several weeks at a time during these low water periods. By means of the construction of storage dams on nine lakes on the water shed of the South River, stream flow conditions were improved and controlled to such an extent that the operation of the steam plant was required only during exceptionally cold weather, and by means of an additional generating station at Bingham Chutes, approximately six miles up stream from the Nipissing plant the same water could be used for both developments, thus obtaining maximum economy from the available water and at the same time enabling the steam plant auxiliary at North Bay to be dispensed with entirely.

Before undertaking the construction of the Bingham Chutes development the Commission's engineers redesigned the two turbines at the Nipissing development, which involved the replacing of both the runners and gates of each unit. These changes enabled provision to be made for increased generating capacity and two new generators were accordingly purchased. The first reconstructed unit has been in operation for somewhat over a year, and the second one will probably be placed in service again about April 1st. A new bank of step-up transformers has also been installed which provide for transformation of the additional generating plant capacity. The net result of these various changes at the Nipissing development has been an increase in the total capacity thereof of approximately 100 percent. These changes released two generators and a bank of transformers, all of which equipment has been used at Bingham Chutes. The accompanying map gives the location of both developments, and the transmission lines between same and North Bay, Callander, and Powassan, as well as the nine lakes in the water shed of the South River previously referred to, from which storage facilities are obtained.

The dam at the Bingham Chutes development consists of a main section constructed of concrete 140 ft. long with earth fills on either side 240 ft. and 80 ft. long respectively, with sluices in the centre section 80 ft. in width. The maximum height of the dam at the centre section is 26 ft., the difference in elevation between head and tail water being 47 ft. The pondage above the dam approximates 100 acres. The water is carried to the power house through an 8 foot wood stave pipe 340 ft. in length and constructed of British Columbia fir. The power house building is constructed of concrete to a point 5 ft. above the substructure, the balance of the building being of red brick which was obtained from Huntsville, Ont. The roof is also of concrete construction covered with prepared roofing material. The dimensions of the building are 35 ft. by 45 ft. by 19 ft. in height. The concrete construction above the substructure is to take care of flood conditions, and channels are so placed in the doorways as to permit the use of stop logs at such openings, thus making it possible to cope



with high water up to a point 5 ft. above the power house floor without endangering the power house equipment.

The turbines are of the double runner horizontal type with cylindrical casing and cast steel fly wheel, they are controlled by Woodward Oil Pressure Governors, and are designed to operate at 450 rev. per min., being rated at 650 b.h.p. They were constructed by the Wm. Kennedy & Sons, Ltd., of Owen Sound.

The generators as previously men-

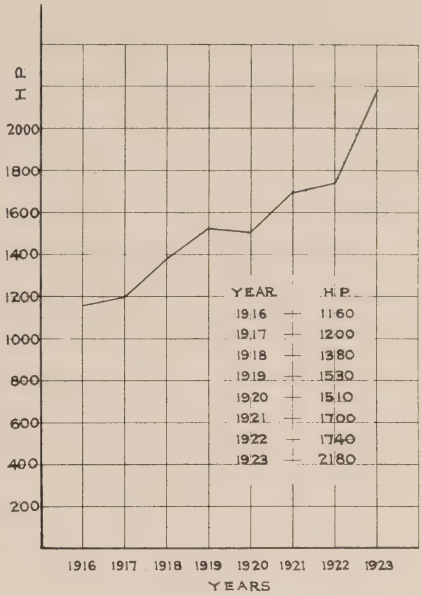
tioned were obtained from the generating plant at Nipissing. They were originally constructed by the Canadian Westinghouse Co., and are rated at 450 kv-a. 3-phase, 60 cycles, 2200 volts, and equipped with direct connected exciters 12½ kw., 125 volts. One bank of step-up transformers provide for transformation from 2200 to 22,000 volts. These transformers were also obtained from the Nipissing plant, they are oil insulated, water cooled, the cooling water being obtained from the penstocks, and are rated at 300 kv-a. each. They are equipped with voltage taps on both primary and secondary, the total capacity of the bank being 900 kv-a., and the connection between generators and transmission line being delta delta. The switching equipment was furnished by the Ferguson Palin Co., and Weston meters are used for the indicating instruments and Westinghouse graphics for the totalizing meters. The protective equipment consists of S. & C. arresters and H.E.P.C. choke coils, fuses and disconnecting switches, approximately 2900 ft. of 22,000 volt, three-phase transmission line has been constructed to connect the generating station with the main line at Powassan. This line consists of No. 0 S.R. Aluminum conductor carried on 35 ft. poles spaced at 135 ft. A private telephone line is also carried on these poles to facilitate satisfactory operation of the generating station. It is anticipated that at some future date the Bingham Chutes development will be converted into an automatic station to be controlled from the Nipissing development.

The construction of this development was carried on by the construction Department of the Commission throughout, and was begun on April 24, 1923, and the first unit placed in operation December 2, 1923. The second unit is now being installed and will be placed in operation on or about April 1st. Difficulties in construction were encountered when the work was first started, on account of Spring floods, and also by the peculiarities of the rock formation which was of granite but full of checks and seams, and on one particular occasion blasting operations at the power house site drained a pool of water above the Gate House located at a distance of about 400 ft. On account of this formation it was found necessary to remove considerably more rock than the original design provided for, but in spite of this difficulty the work has been carried on within the estimates.

To provide a suitable generating auxiliary for the Nipissing system and to supplement the combined capacities of Bingham Chutes and Nipissing developments during low water periods, and to provide for interruptions on the transmission lines between same and North Bay, the Commission has constructed in the latter municipality a Diesel Oil Engine Plant of approximately 600 h.p. capacity. The engines were originally constructed for submarine units for the Chilean Government by the New London Ship & Engine Co., of Groton, Connecticut. These submarines actually made a trip down the east coast of the United States through the Panama Canal, down the west coast of South America around Cape Horn and up the east coast to St. John, New Brunswick.

The submarines were taken over by the United States Government during the war and transferred to the Canadian Government, and the Commission was able to purchase these oil engines at a very low figure. These Diesel Engines are each rated at 300 h.p., at 500 rev. per min. A 300 kv-a generator is direct connected to one of these engines and a 250 kv-a. generator is belt driven by the other, the characteristics of both these generators being 60 cycle, three-phase, 2200 volts. One was obtained from the original North Bay steam plant and the other from the temporary power plant used for construction purposes at the Nipigon development, Thunder Bay district. Each unit is equipped with a belt driven exciter. Both of these generators are so installed as to be used as a synchronous condenser for power factor correction on the system, starting facilities being taken care of by means of a 25 h.p. induction motor. When used as condensers, the generators will be uncoupled from the prime movers. The accompanying curve portrays graphically the growth of load on the Nipissing system during the period of operation by the Commission; the tabulation of loads represents the maximum demand established each year during the same period, all of

CURVE SHOWING GROWTH OF LOAD ON NIPISSING SYSTEM



which indicates the necessity of the additional generating capacity which has been provided to take care of same. For future growth additional storage and generating capacity will be obtained from Cox's Chutes, which is located approximately ten miles up stream from Bingham Chutes, and which will provide from 2000 h.p. to 4000 h.p. additional plant capacity and at the same time, with the dam constructed to maximum elevation, will practically double the available existing storage on the water shed.

Revision of Electricity Inspection Act

By W. P. DOBSON

Laboratory Engineer, H.E.P.C. of Ont.

THE Writer went to Ottawa on February 14, and in company with a deputation from the Canadian Electrical Association consisting of Messrs. P. T. Davies, A. A. Dion, Turley and Holtby, waited upon Mr. Higman.

Mr. Higman read to us a draft of

his revised Electricity Inspection Act, and invited our comments. The main features of the Act as compared with the previous Act passed in 1907, and our comments thereon are given below.

1. *Unit of Supply.* The unit specified previously was the kilowatt-hour or the ampere-hour at a stated voltage. Acting upon the recommendation of the deputation, Mr. Higman agreed to modify this so that the unit of supply should be the kilowatt-hour, kilowatt or kv-a, thus permitting these units to be used for billing purposes.

2. The period of reverification of meters has been extended to seven years; it was formerly five years with an additional time allowance of one year.

3, The penalties for variation of voltage, which were incorporated in the old Act, have been deleted.

4. The new Act requires that the District Inspector shall be notified of the change of location of any verified meters from one inspection district to another, giving the number of the meter and other description of it which may be necessary. This was assented to by the deputation, it being understood that it applied only to meters which were moved without the seal being broken.

5. Mr. Higman also proposed to demand that the clause of the old Act be retained, which provided that a duplicate of each reading of any meter should be left with the customer. There was considerable objection to this as an impracticable rule, and it is my understanding that Mr. Higman agreed to withdraw it.

6. *Sealing of Meters.* The revised wording of this section is still not satisfactory as it makes no exception of graphic meters, demand meters and other types of meters which it is not now practicable to seal. Mr. Higman, however, stated that this clause had not been and would not be interpreted literally. It was suggested by one of the deputation that the clause might state that if any customer desired, a verified meter shall be installed at his request. This would be in addition to any other meters which might be necessary for the Power Company in measuring the load.

7. The old Act provides a penalty if any person, other than an Inspector, verifies or stamps any meter after it has been fixed for use. Mr. Higman proposed to retain this clause and provide a penalty for the verification of any meter or for the issuance of a certificate on any meter after it had been fixed for use by any person other than an Inspector. Objection was taken to this clause as being impracticable and unjust, and Mr. Higman finally agreed to modify this clause.

It will be seen from the above that the efforts of the A.M.E.U. and the Canadian Electrical Association to extend the period of verification of meters has met with a certain amount of success in that the period has been extended by one year.

Hydro Lamps Being Misrepresented

A NUMBER of Hydro Municipalities have been approached recently by manufacturers of electric lamps soliciting orders for a cheap grade of lamps, usually "seconds", which can be sold to customers at a low price.

The practice is ostensibly for the purpose of stimulating a demand for Canadian lamps, to offset the effect of foreign importation. This would not be a bad practice, were it not for the fact that where Hydro Municipalities have been solicited, manufacturers of these cheap lamps have agreed to etch the lamps for these Hydro Municipalities in any way that they may desire, and lamps have been placed on the market, sold to Hydro Municipalities, and resold to consumers, with the etching "Hydro Shop" in circular fashion permanently affixed to the bulb. A sample of the design is submitted herewith.

The Label of Quality

The Other Label

Comparing this design with the regular trade-mark design appearing on *Hydro Lamps* of *High Quality,* one cannot but feel that the etching referred to above, and as illustrated, is put on the lamps with the express purpose of representing to the public that the lamps thus being offered for sale are *Hydro Quality Lamps.*

To the unsuspecting customer the similarity of design creates no doubt in his mind that these lamps are *Hydro Lamps,* and it is only when he takes them home, and finds that they give poor service, that he knows he has been misled into buying something under a misrepresentation.

If he is not so fortunate as to think thus far, he is liable to believe that since these lamps have the word "Hydro" on them, and are of poor quality, that if he is offered genuine *Hydro Lamps,* with the genuine Hydro label on them, these *Hydro Lamps* are likewise inferior in quality, and he is most liable to refuse to purchase them again.

Hydro Lamps have been developed at the express desire of the Hydro Municipalities to give *Long Life,* and first quality *Hydro Lamps* have been giving wonderful satisfaction to Municipalities and consumers alike, and we have reached the point where the experimental stage has been passed and a demand is being created for *Hydro Lamps,* where quality counts with the consumer. If we are to continue to fulfill the desires of Hydro Municipalities and Hydro customers by producing the *Hydro Lamp,* any attempts at misrepresentation by others should be looked upon with scorn, and any solicitations made to Hydro Managers, by other manufacturers, for orders for lamps to bear a label containing the word "Hydro" should be discouraged to the utmost, as by offering these lamps for sale Hydro Managers are parties to the misrepresentation. From a co-operative standpoint that should be the last thing that Hydro Managers would do, and

from a manufacturer's standpoint it is a poor way to solicit business.

Hydro Lamps stand on their merits, and we need not imitate the product of others, nor represent our product as being that of some other manufacturer. The actions of our competitors in imitating the *Hydro Lamp* shows that the *Hydro Lamp* is worth imitating; that it has some very good qualities, which they are trying to capitalize for their own benefit. We ask every Hydro Municipality to co-operate with us in thwarting the efforts of these base imitators in their misrepresentations.

Accounting and Public Relations

Amiable Contacts of this Department with Customers Important —Individual Employee Interest Essential for Building Goodwill

By E. A. DAVIS

FOR the average-sized company accounting work, in so far as it affects public relations, divides sharply into two separate and distinct functions—(a) direct dealing with the public; (b) indirect dealing with the public. In the first division is the direct contact with the customers at the cashier's window, at the order and complaint desk, and the incoming telephone calls. In the second division come the keeping of the customer's accounts, the rendering of bills, statements and the correspondence with customers. The handling of collections comes under both divisions and is a matter of great importance in its influence on public relations.

Considering their direct contact with the public, the work of the members of the accounting department wields a greater influence for good or for ill on public relations than that of any other classified group of employees of a public utility. To the public, in the case of companies of average size, the accounting people very nearly represent that intangible entity—the company—generally referred to by the public as "the office."

THE ORIGINAL COMPANY.

Illustrative of this, let us consider Bill Smith. Bill lives in a rural community of, say, one thousand people. Being mechanically inclined and having a head for business, he thinks an electric plant would do well in the community in which he resides. So he puts his thoughts into action and installs a small gasoline-engine-driven generator, strings wires around the town and sets himself up as a budding public utility owner and operator. Everybody in town knows Bill so that if anything in connection with the service calls for a complaint or correction, it is a simple matter for them to drop in on Bill

and have things rectified. Years pass. The town prospers beyond expectations of the most optimistic. Bill begins to learn that financing a public utility in a rapidly growing community is far beyond his ability. As a solution a corporation is organized with ample capital and financial backing to conduct the affairs of the utility successfully. Bill is glad to accept a fair price for his business and to retire from the field which has been giving him much worry for several years.

The new corporation opens and equips a modern office. Modern accounting methods are installed, and immediately a changed condition confronts the community. No longer does the electric plant represent Bill Smith. Hereafter grievances of any nature will not be taken up with Bill but with "the office". So that the accounting department, which comes in contact with the public now, typifies the Bill Smith of former days. Upon it rests the burden of seeing that to each customer who comes in the office with a grievance, be it ever so trivial, is accorded a courteous, sympathetic and patient hearing. Courtesy, sympathy and patience should not be forgotten, because these necessary attributes are the roots of building up good will. Every clerk must bear in mind that to the customer he typifies Bill Smith.

The case of customers coming to the office with their grievances has been stressed particularly for the reason that such cases require the most careful handling; for here public relations are strained, and it is of utmost importance that this condition be relieved. But in daily routine of business in contact with the public a great influence can be exerted toward improving public relations or maintaining good ones. And here again Bill Smith enters the picture. If Bill were on the job, he would very probably be able to greet every customer by name and very likely would inquire as to the state of health of some ailing member of the customer's family, or some other intimate matter. It is this personal touch that creates a friendly atmosphere about a public utility office and brings a favorable reaction from the public. It should be cultivated.

Indirect Contact.

Of first importance in indirect contact with the public is accuracy. Nothing destroys public confidence more quickly than inaccuracies in the rendering of monthly bills and statements. And to discontinue a customer's service for non-payment and then have him present to your gaze a receipted bill for the period is about the most destructive influence on public relations conceivable. Happily it does not occur frequently, but it should not occur at all. It is surprising how deeply an occasional customer's feelings can be wounded by the misspelling of his name on a bill or statement. This is another place where inaccuracies are harmful to the company.

The next item is a matter of neatness—or good housekeeping. Bear in mind that a large percentage of

the customers who come in your office are women. A disorderly, untidy office doesn't cause them to feel any pride in the public utility with which they do business. Men, as a rule, are not so observing of such matters, yet while they may not notice them, unconsciously the effect is bad. Let the personal touch enter here, thereby bringing an air of good housekeeping into the office.

A Self Interest Problem.

In conclusion, let us look this subject of public relation squarely in the face and ask ourselves, "What is it all about? Is it something in which we as individuals have only a detached interest—something that we, as a part of our duties, are supposed to build up and maintain for the benefit of the company?" The answer is, "Most decidedly not". Each public utility employee has a very great and selfish interest at stake. In the first place, he has the selfish interest of his own personal advancement, which will be better assured with a growing and successful public utility company, because a company to qualify in this class requires good public relations as a main essential. Furthermore, if his relations are good, his day-to-day dealings with the public are a pleasure, his lot in life is the happier as a result. His selfish interest, therefore, lies in seeing that those favorable relations are maintained. If the opposite is the case, if poor or bad public relations exist, the company which employs him does not flourish. His own progress accordingly is checked, and his day-to-day dealings with the public are far from being a pleasure. His selfish interest clearly lies in seeing that these relations are improved.

—Electrical World.

The First World Power Conference

Those desiring further information regarding Canadian Participation in the World Power Conference should address their communications to Mr. J. B. Challis, General Secretary, Dominion Water Power Branch, Department of the Interior, Ottawa, Ont.—The Editor.

THE December Bulletin gave a short notice of the First World Power Conference to be held at Wembley, London, England, from June 30th. to July 12th. This conference is promoted by the Council of the British Electrical and Allied Manufacturers' Association (Incorporated) in co-operation with Technical and Scientific Institutions and Industrial Organizations in Great Britain and Other Countries.

The idea of a World Power Conference originated in England in the year

following the declaration of war when the relationship of power to production was brought forth with vivid force. It remained, however, quiescent until the British Electrical and Allied Manufacturers' Association evolved the scheme of holding such a conference at the time of the British Empire Exhibition. A British Committee was thereupon formed comprising the various technical and scientific institutions and industrial organizations in the British Isles and invitations were sent to various countries throughout the world to participate.

Upon the receipt of the invitation of the British Committee a provisional Canadian Committee was formed early in 1923 comprising sufficient Dominion, Provincial and Corporate interests to make it geographically representative of the whole Dominion. At the meetings of this committee it was unanimously decided to participate in the conference and arrangements were made to have as a commencement five papers prepared covering the most outstanding features of the power situation in Canada. Later a general advisory Committee was organized comprehensive of all power and allied interests in the Dominion. This committee met in December, endorsed the actions of the preliminary committee and formed a management committee to arrange for appropriate Canadian participation in the conference.

A preliminary meeting of representatives of national committees held in London in August, 1923, was attended by a member of the Canadian Committee and an outline of programme and procedure agreed upon. It was also arranged that papers for submission at the conference will be printed and distributed by the British Committee to the members of the several national committees sufficiently early to allow examination and study prior to the opening of the conference. These papers will not be read but the sessions will be devoted to oral discussion of the subjects with which they deal.

The scope of the conference covering the power resources of all participating countries and the technical and economic problems of power development, transmission and utilization should prove of surpassing interest and value to those who are privileged to attend and to those countries which they represent. For Canada it will afford a unique opportunity to present before the world her magnificent power resources both hydro and fuel and the efficient and economic manner in which they have so far been utilized.

The purpose of the World Power Conference will be to consider how the industrial and scientific sources of power may be adjusted nationally and internationally:

By considering the potential resources of each country in hydro-electric power, oil and minerals.

By comparing experiences in the development of scientific agriculture, irrigation and transportation by land, water and air.

By conferences of civil, electrical, mechanical, marine and mining engineers, Technical Experts and au-

thorities on Scientific and Industrial Research.

By consultations of the Consumers of Power and the Manufacturers of the Instruments of Production.

By conferences on Technical Education to review the educational methods in different countries, and to consider means by which existing facilities may be improved.

By discussions on the financial and economic aspects of industry, nationally and internationally.

By conferences on the possibility of establishing a Permanent World Bureau for the collection of data, the preparation of Inventories of the World's Resources, and the exchange of industrial and scientific information through appointed representatives in the various countries.

The classified program is outlined as follows:

Division 1: Power Resources.

Section A: Power Resources, National Reviews.
General Survey, Power Resources, Available and Utilized, Administration, Power Requirements.

Division II: Power Production.

Section B: Water Power Production.
Section C: Preparation of Fuels.
Distillation of Coal, Pulverized Coal, Distillation of Shales, Oil Refining, Lignites, Peat.
Section D1: Steam Generation.
Boilers, Utilization of Fuels, Waste Heat.
Section D2: Steam Turbines
Section E1: Internal Combustion Engines, Crude Oil.
Section E2: Internal Combustion Engines, Gas, Oil and Spirit.

Division III. Power Transmission and Distribution.

Section G1: A.C. Transmission and Distribution.
Generators, Motors, Transformers & Switchgear, Transmission Lines, Underground Cables.
Section G2: High-Voltage Direct-Current Generation, Transmission and Distribution.

Division IV: Power Utilization.

Section H: Power in Industry and Domestic Use.
Section J: Electro-Chemistry and Electro-Metallurgy.
Section K1: Power for Land Transport.
Section K2: Power for Water Transport.
Section K3: Power for Air Transport.
Section L: Illumination.

Division V: General.

Section M: Economic, Financial and Legal Aspects of Power.
Section N2: Standardization.
Section N3: Education.
Section N4: Health.
Section N5: Publicity.
Section N6: British Empire Resources.

The British Committee makes the following preliminary announcement

as to conditions and privileges of membership.

ORDINARY MEMBERS.—Any applicant, subject to the approval of the Executive Commitee, is entitled to become a member of the World Power Conference on payment of the sum of £2, which will be used towards defraying the stenographic and other expenses incident to the conduct of the Conference.

Members will receive a Membership Ticket, which will entitle them to free admission to the British Empire Exhibition and the Conference Halls, during the period of the Conference. These tickets will be personal and not transferable.

Members, if they desire it, can purchase, at a nominal price, copies of papers in the Sections in which they are interested, the charges for which will be announced at a later date. These copies will be available for Members only. Papers will be on sale at the Hall, but Members who wish to take part in the discussions should apply in advance for such papers as they may require.

OFFICIAL DELEGATES.—The official delegates appointed by the participating National Committees are entitled to Free Membership.

Copies of the papers for presentation at the Conference will be sent free to official delegates in advance of the Conference, through their respective National Committees.

ACCOMMODATION. — The Organizers of the Conference, through their official Travel Agents, will be glad to assist members in obtaining hotel accommodation in London, though they cannot guarantee to obtain such accommodation. Members are requested to make early application for such accommodation as they may require.

OFFICES AND ENQUIRY BUREAU. —The Organizers of the Conference are arranging for offices at the Conference Halls for the use of Members, full particulars of which will be announced later. An Enquiry Bureau and Postal Facilities for the use of Members will also be provided.

OFFICIAL RECEPTIONS AND SOCIAL FUNCTIONS. — A special Committee has been formed to arrange official receptions and social functions and announcements will be made at a later date.

OFFICIAL TOURS AFTER THE CONFERENCE.—Official tours in which only delegates and Members of the Conference will be entitled to participate are being arranged to follow the Conference.

The tours will be conducted with the co-operation of the National Committees in each country and in consultation with Messrs. Thos. Cook & Sons, the Official Travel Agents of the Conference. These include Great Britain, Norway, Sweden, Lapland, France, Switzerland and Italy, when opportunities will be given to visit works, scenic districts and other places of interest in those countries. It is estimated that £60 should cover the cost of each of the tours but the final cost cannot be determined until the various National Committees concerned have completed their arrangements.

Association of Municipal Electrical Utilities

Minutes of Meeting of Executive Committee

THE meeting was called to order at 10.00 a.m. on Tuesday, February 12, 1924, at the office of the Hydro-Electric Power Commission of Ontario, by the President, Mr. J. E. B. Phelps. Other members of the Executive present were:—Messrs. V. S. McIntyre, J. E. Skidmore, O. H. Scott, M. J. McHenry, W. R. Catton, J. G. Archibald, E. J. Stapleton, G. J. Mickler and S. R. A. Clement, Secretary.

The Secretary read a letter from Miss M. L. Oliver, Secretary, Niagara Hydro-Electric Commission, extending on behalf of that Commission an invitation to the Association to hold its summer convention at Niagara.

He also read correspondence between the President and Mr. T. J. Hannigan, Secretary, Ontario Municipal Electrical Association in reference to the proposed affiliation of the A.M.E.U. and the O.M.E.A.

After taking up the correspondence with Mr. Hannigan together with the resolution passed at the January Convention in reference to the proposed affiliation it was—Moved by Mr. O. H. Scott, and Seconded by Mr. E. J. Stapleton, THAT the Executive recommend to the Association that the suggestion of Mr. Hannigan, Secretary, Ontario Municipal Electrical Association be not accepted and that Mr. Hannigan be sent a letter explaining the reasons for the same.

CARRIED.

The various suggestions for the location of the summer convention were then considered. It was moved by Mr. W. R. Catton, and seconded by Mr. M. J. McHenry, THAT the summer convention be held at Niagara Falls on June 26, 27 and 28.

CARRIED.

The Secretary was instructed to circularize the commercial members to ascertain whether a commercial exhibit was desired.

It was moved by Mr. V. S. McIntyre, and seconded by Mr. E. J. Stapleton, THAT the Secretary and the Treasurer be paid a gratuity of $125.00 each. CARRIED.

It was moved by Mr. V. S. McIntyre, and seconded by Mr. J. G. Archibald, THAT the Treasurer invest the surplus funds of the Association in bonds. CARRIED.

The various committees for the year 1924 were then drawn up.

It was moved by Mr. O. H. Scott, and seconded by Mr. E. J. Stapleton; THAT the Papers' Committee consist of Messrs. V. S. McIntyre, Kitchener, Chairman; M. J. McHenry, Walkerville; P. B. Yates, St. Catharines; A. B. Cooper, Ferranti Meter & Transformer Co., Toronto; C. E. Schwenger, Toronto; and R. T. Jeffery, H.E.P.C. of Ontario, Toronto.

CARRIED.

It was moved by Mr. M. J. McHenry, and seconded by Mr. J. G. Archibald; THAT the Convention Committee consist of Messrs. W. R. Catton, Brantford, Chairman; P. B.

Yates, St. Catharines; J. E. Teckoe, Niagara Falls; R. H. Starr, Orillia; C. H. Hopper, Canadian Westinghouse Co., Toronto; A. S. McCordick, Moloney Electric Co., Toronto; W. R. Greenshields, Canada Wire & Cable Co., Leaside; and J. J. Jeffery, H.E.P.C. of Ontario, Toronto.

CARRIED.

It was moved by Mr. E. J. Stapleton, and seconded by Mr. J. E. Skidmore; THAT the Regulations' and Standards' Committee consist of Messrs. O. H. Scott, Belleville, Chairman; J. J. Heeg, Guelph; E. J. Stapleton, Collingwood; J. E. Brown, Ottawa; W. P. Dobson, H.E.P.C. of Ontario, Toronto; and A. G. Hall, Electrical Inspection Dept., Toronto.

CARRIED.

It was moved by Mr. J. G. Archibald, and seconded by Mr. O. H. Scott; THAT the Committee on Accident Prevention and Health Promotion consist of Messrs. M. J. McHenry, Walkerville, Chairman; W. R. Catton, Brantford; E. M. Ashworth, Toronto; F. C. Adsett, Trenton; T. C. James, H.E.P.C. of Ontario, Toronto; Wills Maclachlan, H.E.P.C. of Ontario, Toronto; and S. R. A. Clement, H.E.P.C., Toronto.

CARRIED.

It was moved by Mr. J. G. Archibald, and seconded by Mr. W. R. Catton; THAT the Merchandising Committee consist of Messrs. J. E. Skidmore, Cobourg, Chairman; O. M. Perry, Windsor; E. V. Buchanan, London; E. W. Tobin, Stratford; W. H. Childs, Hamilton; O. H. Scott, Belleville; A. B. Scott, Galt; A. W. J. Stewart, Toronto; M. J. McHenry, Walkerville; J. J. Heeg, Guelph; A. Sauder, Kitchener; H. F. Shearer, Welland; and G. J. Mickler, H.E.P.C. of Ontario, Toronto. CARRIED.

It was moved by Mr. W. R. Catton, and seconded by Mr. O. H. Scott; THAT the Rates' Committee consist of Messrs. G. J. Archibald, Woodstock, Chairman; P. B. Yates, St. Catharines; J. R. McLinden, Owen Sound; E. I. Sifton, Hamilton; E. M. Ashworth, Toronto; H. O. Fisk, Peterboro; J. G. Jackson, Chatham; E. V. Buchanan, London; J. J. Heeg, Guelph; M. M. Inglis, Port Arthur; A. B. Scott, Galt; R. H. Starr, Orillia; and all of the members of the 1924 Executive Committee.

CARRIED.

It was moved by Mr. M. J. McHenry, and seconded by Mr. J. E. Skidmore; THAT the Auditors be Messrs. W. G. Pierdon, H.E.P.C. of Ontario, Toronto; and R. C. McCollum, H.E.P.C. of Ontario, Toronto.

CARRIED.

The meeting adjourned at 11.30 a.m.

A. M. E. U. CONVENTION

Niagara Falls, June 26, 27, 28, 1924

See April Bulletin for further details

HYDRO NEWS ITEMS

Niagara System

The Commission has purchased the complete plant and business of the Welland Electric Company Limited for the sum of $75,000.00. The plant was taken over by the Commission on March 1 and will be changed over to 25 cycles as quickly as possible.

The Welland Hydro-Electric System will take over that part of the Company's system located in Welland, and the customers will be transferred to the lines of the Welland Hydro-Electric System, and the duplicate pole lines will be removed from the City streets.

The Company's system in Fonthill will be sold to that Municipality, and the lines in the rural districts will be retained by the Commission and incorporated into the Welland rural power district.

* * *

Mr. S. A. Ord, formerly Secretary of the Preston Commission has recently been employed by the Commission as Superintendent of the Welland rural power district.

* * *

The Windsor Hydro-Electric System recently purchased a lot in the southern part of the City, on which they propose to erect during the coming year another sub-station to take care of their rapidly increasing load.

* * *

Rideau System

Mr. M. W. Roger, formerly Perth Hydro System has taken charge of the Carleton Place Utilities. Mr. W. Moffatt, formerly in charge has left for Kirkland Lake where he was formerly engaged.

* * *

The Kemptville Hydro Commission has entered an injunction restraining the Kemptville Milling Company from bringing power within the corporate limits.

* * *

St. Lawrence System

The Williamsburg Rural Power District commenced operation on February 12th.

* * *

The Council of the Township of Osnabruck has forwarded a petition from residents of the Township asking for estimate on cost of rural service.

List of Electrical Material, Devices and Fittings

Approved by The Hydro-Electric Power Commission of Ontario in February 1924.

Appliances

SINGER SEWING MACHINE COMPANY, (Submittor), 904 Excelsior Life Bldg., Toronto.

SINGER SEWING MACHINE COMPANY, (Mfr.), 149 Broadway, New York, N.Y.

Electric Sewing Machines, Cat. Nos. 101-1 to 101-10 incl.

* * *

GROH REFRIGERATION CO., 48 Abell St., Toronto.

Electric refrigerator "Groh".

* * *

BURLINGTON ELECTRIC COMPANY, (Submittor), Burlington, Ont.

THE ROGERS ELECTRIC LABORATORIES CO., (Mfr.), 2015 East 65th. St., Cleveland, Ohio.

Portable Electric Hot Plate.

* * *

DUFFIE ELECTRIC MANUFACTURING CO., LIMITED, 465 Bloor St., W., Toronto.

Air Heaters "Tropical", Cat. Nos. 6 and 9.

* * *

THE HOLTZER-CABOT ELECTRIC CO., Boston 19, Mass.

Electric Motors "Holtzer-Cabot". 1 h.p. and less.

* * *

NORTHERN ELECTRIC COMPANY, LIMITED, (Submittor), 131 Simcoe St., Toronto.

FORT WAYNE ENGINEERING & MANUFACTURING CO., (Mfr.), Fort Wayne, Ind.

Electric Water Systems "Paul".

* * *

SIMPLICITY ENGINE & MFG. CO., Port Washington, Wis.

Motor-operated Boring and Grinding Machine "Simplicity".

* * *

THE D. MOORE COMPANY, LIMITED, Hamilton, Ont.

Electric Hot Plates, Cat. Nos. 16, 18, 21, 129.

* * *

FINDLAY BROS. CO., LIMITED, Carleton Place, Ont.

Electric Range, low oven type, "Findlay".

* * *

THE GURNEY FOUNDRY COMPANY, LIMITED, 500 King St., W., Toronto.

Electric Range, cabinet type, "Gurney", Cat. No. 4901.

* * *

*STRAND & COMPANY, N.A. 5001 N. Lincoln St., Chicago, Ill.

Portable Motor with Flexible Shaft and Chuck, "Strand", Type M-5.

* * *

*AMERICAN FLYER MFG. CO. 2219-39 S. Halsted St., Chicago, Ill.

Toy Transformers, Cat. Nos. 1249A, 1250A.

* * *

*CLEVELAND KLEEN-KUT MFG. CO., THE, 720 Bolivar Rd., Cleveland, Ohio

Meat Chopping Machines, "Kleen-Kut", Cat. Nos. IE-Type-B, 322.

* * *

*WESTINGHOUSE ELECTRIC & MFG. Co., East Pittsburgh, Pa.

Cooking and Liquid Heating Appliances.

Disc Stoves, Styles 189198, 189204, 270701.

Table Stoves, Styles 196158, 214903, 280112-3.

Toaster, Model B, Styles 266963, 266965.

Waffle Iron, Styles 284186-7, 284284-5.

Water Heaters, "Bayonet", Styles 186054-149 inclu.

Ranges, Styles 266931-33-35 etc. to 61 inclu., 278604-11 inclu., 27881-932 incl. Types M-1 and M-2, styles 299729-31-33-35 etc. to 67 incl.; Type 2-19B, Styles 327948; Type 3-19B, Styles 327678-A, 327680-A, 327857-A, 328329-A, 328331-A.

Hot Plates, Styles 231562, 231564, 231566-69 incl., 266968-70-72-74.

Percolators, Styles 284057-8, 251-401-03 incl., 262739-41 incl., 280735-7 incl.

Urn Heater, Styles 299976-981 incl.

Industrial and Laboratory Heating Appliances.

Solder Pots, Styles 133628-33 incl. 299708, 299861, 299862.

Fittings

A. L. WYNSTON, JR., (Submittor), 77 York St., Toronto.

FITTINGS LIMITED, (Mfr.), Oshawa, Ont.

Conduit Boxes, Types A, B, C, E, F, G, H, J, K, LB, LL, LR, LF, T, X.

* * *

*CONNECTICUT ELECTRIC MFG. CO., THE, Bridgeport, Conn.

Fuseless Attachment Plugs.

Separable and non-separable attachment plugs having composition base and cap, Cat. Nos. 1000, 1010.

Caps only Cat. Nos. 1012, 1013.

Separable and non-separable attachment plugs having bakelite base and cap, Cat. Nos. A-1 and A-2.

Caps only, Cat. Nos. A-12 and A-22.

Current Taps with cap, Cat. No. 1061, without cap, Cat. Nos. 999, 1063.

* * *

*BRYANT ELECTRIC CO., THE, Bridgeport, Conn.

Receptacles for Attachment Plugs and Plugs.

Combination for use on ranges, Cat. No. 136.

Heater control combination, Cat. Nos. 437, 117, 398, 413, 419, 438, 465, 467, 469, 495, 514-15, 518, 121, 558, 466, 439.

* * *

*MAGNUS ELECTRIC CO., INC., THE, 451 Greenwich St., New York.

Fuseless Attachment Plugs, Cat. Nos. 22, 48, 95.

* * *

*PASS & SEYMOUR, INC., Solvay, N.Y.

Medium Base Receptacles.

"P. & S." Metal Shell.

Key, Cat. Nos. 601, 611, 613, 615, 617-623 incl., 627, 656, 657, BR-S20, BR-S30.

Keyless, Cat. Nos. 1, 44, 78, 85, 108, 146, 414, 1009-10, 7531, 7533, 7535, 7557, 7559, 50717, 60020, 60387, 60431, 61456, 62351, 68137, BR-S21, BR-S31.

Switches

HARVEY HUBBELL COMPANY OF CANADA, LIMITED, 7 Labatt Ave., Toronto, Ont.

Surface Switches, "Hubbell" toggle

pattern, single pole, Cat. No. 8171. Double pole, Cat. No. 8102.

Flush Switches. "Hubbell" toggle pattern, single pole, Cat. No. 8141. Double pole, Cat. No. 8122.

* * *

SQUARE D COMPANY, Walkerville, Ont.

Service entrance switches, Cat. Nos. 6311, 6312, 6313.

* * *

*SQUARE D. COMPANY, Detroit, Mich.

Enclosed Switches, Cat. Nos. 32211, 32311, 34211, 34311, 36211, 37211.

* * *

*ARROW ELECTRIC CO., THE, Hartford, Conn.

Surface Switches (as listed on Underwriters' Laboratories' Card, dated January 22, 1924).

* * *

*UNDERFEED STOKER COMPANY OF CANADA, LTD., THE,, Toronto, Ont.

Automatic Switches.

* * *

*MERCURY TIME SWITCH CO., 103 W., Atwater St., Detroit, Mich.

Automatic Switches, Types 1 and 2-pole.

* * *

*TRUMBULL ELECTRIC MFG. CO., THE, Plainville, Conn.

Enclosed Switches, Cat. Nos. 5791, 5791A, 5793, 5793A, 5893, 5893A, 13640-42 incl.,13549-51 incl., 13551-½, 13552-53, 13553-½, 13554-55, 13642A, 13643, 13643A, 13742, 5650-53 incl., 13221, 13321, 13560, 13562, 13564, 13566.

Flush Switches, Cat. Nos. 231, 232, 7477-78, 233, 204.

Surface Switches, (as listed on Underwriters' Laboratories' card, dated June 5, 1923.)

Panelboards, Types PP, PT, CP, CT.

* * *

*These devices are under the Underwriters' Laboratories re-examination or label service.

Equipment for Sale

Municipalities desiring the insertion of Notices under this Heading should have Copy of the same reach the Editor by the 10th of the Month of issue.

1—150 kv.a., three phase, 60 cycle, 2300 volt, generator with belt driven exciter. Full information on request. Hydro-Electric Power Commission of Ontario, 190 University Avenue, Toronto.

THE
BULLETIN

Published by
HYDRO-ELECTRIC POWER COMMISSION
of Ontario

190 University Avenue
Toronto

Subscription Price $2.00
Per Year

Ontario's Experience

By SIR ADAM BECK

Chairman, Hydro-Electric Power Commission of Ontario

THAT more than 380 municipalities acting co-operatively invested about $250,000,000 in a common undertaking for the distribution of electrical energy to their citizens, that this organization has been in successful operation in Ontario for nearly fifteen years and that it is accumulating large financial reserves while supplying electric light and power over extensive areas at unprecedentedly low rates, are facts which have attracted world-wide attention.

In its essence, the "Hydro" electric power undertaking of Ontario is an organization of a large number of partner municipalities, co-ordinated for securing common action through the medium of the Hydro-Electric Power Commission which acts as their trustee. As such, the Commission generates or purchases electrical energy which it transmits to the associated municipalities. Each municipality owns its local distribution system and distributes the power to its individual customers. These individual customers in turn, are charged rates which will meet the cost of power furnished to the municipality by the Commission, together with the cost of operation and management of the municipal distribution system.

Absence of coal resources in the province, advances in the art of transmitting electricity, and recognition of the manufacturing potentialities of the country, were the three chief factors which, about 1900, prompted a number of leading manufacturers in southwestern Ontario to look into the possibility of obtaining hydro-electrical energy at rates cheaper than the cost at which power could be generated locally from coal, gas or oil.

It was realized that if the large water-power of the Niagara River could be used as a basis for the widespread transmission of electrical energy throughout the more populous portions of Ontario, then importations of coal could be substantially reduced and Ontario would, thereby, be rendered less dependent upon foreign resources. Interest in Ontario's power problem was greatly stimulated by public meetings and discussions in the

CONTENTS

Vol. XI. No. 4

APRIL, 1924

press. Appeals were made to the provincial government for legislation, and finally, as a result of the general movement, the government of Ontario, in 1903, provided the means by which a commission could be appointed by interested municipalities to investigate the generation and distribution of hydro-electrical energy. The authority thus granted resulted in the appointment by the municipalities of Toronto, London, Brantford, Stratford, Woodstock, Ingersoll and Guelph, of the Ontario Power Commission, which after a thorough investigation, published a comprehensive report in 1906. When the results of this investigation became known, the provincial government, that same year, provided by special act for the creation of the Hydro-Electric Power Commission of Ontario, the organization now in existence. With the exception of the chairman, the personnel of the Commission has changed from time to time, but it is noteworthy that the services of many of the Commission's most important officers commenced with its creation and—notwithstanding several changes in the governments of the Province—they are to-day in responsible charge.

In 1906, by-laws were passed by thirteen Ontario municipalities authorizing their Councils to make contracts with the Commission for a supply of electrical power from Niagara Falls. In 1907, further legislation strengthened and extended the powers of the Commission. One essential difference between the act of 1903 and those of 1906 and 1907 is, that under the former, various municipalities could combine into separate groups operating through separate commissions, whereas under the later acts, all municipalities make their wants known to the provincial Commission which is then able to harmonize their various requirements and co-ordinate the municipalities into groups or districts.

Those entrusted with the formulation of the policy to be pursued by the Commission were impressed with the underlying strength of the industrial and commercial possibilities of the territory seeking the cheaper power and light. Southern Ontario, the area served by electrical energy from Niagara, lies approximately between latitudes 42 and 44. The greater part of this area is further south than much of northern New York state, than the larger portions of the states of New Hampshire, Vermont, Michigan, Wisconsin, Minnesota, South Dakota, Idaho and Oregon, and than the whole of the states of Maine, North Dakota, Montana and Washington. Compared with Europe the area lies in the same

latitude as the south of France. The Province has many climatic advantages. That precipitation throughout Ontario, both in amount and in its seasonal distribution, is sufficient for agricultural purposes and is an asset of prime importance. The whole Province is well watered and with its many streams and lakes replenished from the annual precipitation, the water power developments are in most instances exceptionally well protected. Its agricultural advantages for mixed farming and fruit-growing are well known. Its railway and inland facilities are excellent. In all the large municipalities, the employer of labor contemplating the establishment of new industries may count upon adequate transportation facilities, unsurpassed educational and social conditions, and standards of living and of administration of public affairs equal (in many cases superior) to those to be found elsewhere.

From this brief consideration of the natural advantages of the Province it will be appreciated that with Ontario's background of agriculture its timbering, mining, fisheries and game, there are available supplies of raw materials for an extensive manufacturing industry with marked possibilities for increasing exports from farm and factory. Such circumstances, then, constituted a solid foundation of great promise upon which the Commission could build in establishing a market for the consumption of electrical energy for domestic, commercial and manufacturing requirements.

The lines along which the Commission has conducted its work are easily grasped.

If the people of a municipality want to obtain a supply of power, a vote is taken at the polls, and an enabling by-law passed whereby the municipality may contract for it with the Commission. The Commission's engineers are at the service of the municipality for the purpose of making an estimate of its requirements. The contract having been executed, a money by-law must also be passed by the electors authorizing the municipal council to issue the debentures necessary to cover the cost of constructing a distributing system within its limits. The Commission thereupon proceeds with the work of building up the necessary transmission lines, sub-stations, etc. The municipalities repay the cost of the project out of earnings, spread over a period of thirty years; all such items as maintenance, depreciation and sinking fund being fully taken care of. At the end of thirty years' time the entire plant and equipment will have been paid for, and the people become the owners of a fully-paid-up undertaking.

The basic principle of the whole "Hydro" project is a partnership of municipalities formed to obtain electrical energy at cost, each municipality paying its proportion of the cost for the service received. The Commission, acting as trustee and agent for the municipalities, exercises both administrative and constructive functions, and has evolved a well-defined and successful working policy for the development, transmission and distribution of hydro-electrical power under municipal ownership.

The fundamental basis on which power is supplied is that it must be sold "at cost," but not every one is aware just what is meant by this term.

"Cost," so far as "Hydro" power is concerned, includes all charges arising out of the generation, transmission and delivery of power to the municipalities. These charges include, for each municipality, its share of the interest and sinking fund for the cost of lands, stations and equipment required for supplying power as well as a proportionate part of administration, operation, maintenance, renewal, insurance and all other costs entering into the business of supplying electricity.

The framework of the financial structure of the Hydro-Electric Systems may be set in a few concise statements:

First: The generation and transmission of power on a wholesale scale is dealt with by a Commission which, although appointed by the government of the province, acts independently in the capacity of trustee and agent for the partnership of municipalities.

Second: The local distribution of electrical energy within the borders of a municipality is, in general, under the administration of a public utilities commission appointed under the provisions of the Public Utilities Act.

Third: Capital required for the plant for the generation and transmission of power is provided by the Government upon receipt of formal requisition from the Commission. Contracts are entered into between the Commission and the municipalities under the terms of which the municipalities undertake to repay in thirty years the monies thus loaned by the Government.

Fourth: The local distribution system is financed by the issue of municipal debentures. Provision is made in the rates charged to the ultimate consumers, for revenue with which to retire these bonds also, usually in twenty years.

Fifth: The "Trustee" Commission supplies power to the municipalities, charging each municipality the actual cost. To do this, an interim charge is made monthly based upon the estimated cost, and, at the end of each year, credit or debit adjustment is made of the amount charged, in order to make up the actual total cost—no more and no less. The "cost of power" includes all the usual costs of operation and maintenance of the generating, transforming and transmission plant and equipment, and, in addition, the annual interest charges on the monies borrowed for the initial cost of installation, also provision for renewal (depreciation) and sinking fund reserves, as well as a special reserve fund for contingencies.

Sixth: Each municipality sells electrical energy to its local consumers at rates and under conditions approved by the Commission. The rates charged to its consumers by a municipality are sufficient to take care both of the cost of distribution within the municipality and of the estimated cost of power to be paid to the Commission by the municipality. The cost of distribution is ascertained in a manner identical with that used by the Commission in arriving at its wholesale costs.

Seventh: Under the Power Commission Act, the Commission is required to determine, annually, the actual cost of service supplied to the municipal corporations by the local commissions for such strictly municipal purposes as street lighting and

operating electric-motor-driven pumps in waterworks, and if any profit has accrued through the charging of the rate used throughout the year, this surplus is handed back to the municipal system.

At the outset of the Commission's work, after studying various sources of power for distribution to the munipalities it was concluded best to initiate their co-operative enterprise by purchase from power companies which had extensive plants already erected at Niagara Falls. Consequently in 1908 the Commission, on behalf of the municipalities, entered into a contract with the Ontario Power Company for the supply of 100,000 horsepower of electrical energy at $9.40 per horsepower-year until a load of 25,000 horsepower should be reached, after which the price was to be $9.00 per horsepower-year. The Commission built transformer stations and transmission lines for distributing the power to the contracting municipalities, and by about the end of 1910 was supplying ten urban municipalities. The small initial load of less than 1,000 horsepower increased until in 1914 it was 77,000 horsepower, and by 1915 the Commission had reached the limit of its contract for 100,000 horsepower. In 1920 the load was 356,000 horsepower. The Commission had arranged meanwhile for additional power supply from the Canadian Niagara Power Company of 50,000 horsepower, and from the Toronto Power Company of over 25,000 horsepower. It subsequently purchased outright the Ontario Power Company with its plant capacity of 160,000 horsepower, and more recently acquired the Toronto Power Company with that of 125,000 horsepower. Finally, in its new Queenston-Chippawa plant the Commission has provided for an ultimate development of 600,000 horsepower.

The extent of the Commission's operations is registered by the fact that the high-tension lines alone in its transmission networks aggregate over 3,000 miles.

The municipalities now own and operate a number of hydro-electric systems, including power plants. These systems are: Niagara, Severn, Eugenia, Wasdell's, Muskoka, St. Lawrence, Ottawa, Rideau, Thunder Bay, Central Ontario and Trent, and Nipissing. Of the foregoing, the Central Ontario and Nipissing systems were purchased by the Provincial Government in 1916, their operation being entrusted to the Commission.

Since commencing its operations, the Commission has purchased no less than twenty waterpowers, thirty hydraulic generating plants, and over sixty electric distribution systems. It possesses the right to expropriate private plants; nevertheless—with the single exception of a case at present under consideration—the Commission has not required to invoke its powers of expropriation but has been able to consummate every transaction upon fair terms, satisfactory to the interests immediately involved.

To-day, including exported power, the Hydro-Electric Power Commission of Ontario is distributing about 700,000 horsepower, and operates twenty-one undertakings which, when fully developed, will have a potentiality of over 1,000,000 horsepower.

The Province of Ontario is the

owner of Canada's equity in the water power in the international portion of the St. Lawrence River; this share amounts to over 800,000 horsepower. It often takes several years to prepare the plans and construct the installations necessary to supply large quantities of power, and those who have followed the phenomenal growth in demand for electrical energy will appreciate that it is one of the functions of an organization like the Hydro-Electric Power Commission to appraise existing conditions in the light of future needs. Present conditions clearly indicate that the power markets will be short of power before the St. Lawrence River hydro electric power can be made available even though the work were commenced immediately.

The greatest individual engineering project which the Commission has undertaken is the Queenston-Chippawa power development on the Niagara River. Its general scheme comprises an intake structure in the Niagara river at Chippawa; the deepening and widening of the Welland river between Chippawa and Montrose, a distance of 4½ miles; the construction of a canal 8½ miles long from Montrose to the forebay and screen house at a point on the cliff about a mile south of the village of Queenston; and the construction and equipment of a power house, in the gorge, immediately below the forebay.

Existing power developments on the Niagara river have only utilized that portion of the total fall of the river which occurs in the vicinity of the falls and, for the most part, even this amount of head has been inefficiently utilized. The basic conception of the Queenston-Chippawa development is the utilization of the greatest possible amount of the total fall of the Niagara river between Lake Erie and Lake Ontario at the highest possible efficiency. Of this total fall of 327 feet, about 10 feet occurs in the upper Niagara river from Lake Erie to Chippawa and in the lower river from Queenston to Lake Ontario. These 10 feet it is impossible to reclaim for power purposes. Of the remaining head, about 12 feet is required to convey the water through the canal.

The average head actually available at the power house is 305 feet, and 30 horsepower is developed for every cubic foot of water that flows through the canal per second. That this is a great forward step in economy is apparent from the fact that only 16 horsepower is obtained from each cubic foot of water flowing per second in the most efficient of the present three plants on the Canadian side of the river at Niagara Falls, thus every cubic foot of water used in the Queenston power house will earn nearly twice as much revenue as if it were used at the falls.

The water of the Niagara river, after leaving the canal proper, enters a forebay which is practically a triangle-shaped enlargement of the canal, whence it enters the penstocks or tubes, which lead it down the face of the cliff to the turbines in the power house which is located right on the edge of the river at the bottom of the gorge.

The turbines are technically described as of the vertical single-runner type; their capacity is 60,000 horse-

power each, being greater than that of any others previously built.

Each electric generator is mounted directly above its own turbine, the revolving parts of each having a common shaft. The heaviest single integral part of one of these huge units weighs 300 tons. Air is employed for cooling these generators and the warm air issuing therefrom is used in winter to warm the building; the weight of air required every 2-½ hours for cooling each generator is 690 tons, equalling the total weight of the generator itself.

Three-phase alternating electric current is generated at 12,000 volts, the frequency being 25 cycles per second; the current from each generator passes through its own switches and transformers, the latter being used to step up the voltage from 12,000 volts to 110,000 volts; and the current is transmitted at 110,000 volts on the Commission's high-tension lines all over southwestern Ontario.

Six of the large new generators are now supplying the Niagara system, while of the remaining generators, two are under order for earliest possible delivery. The power canal provides for an ultimate plant capacity of over 600,000 horsepower.

The following table, based upon returns published in the last annual report of the municipalities, will convey some idea of what the charges are for light and power in some of the larger municipalities of Ontario:

The success attained by the Power Commission in distributing hydro-electrical energy, not only to the larger cities and towns, but to villages and hamlets, stimulated the farming communities of rural Ontario to call for "Hydro" service. The problem of distributing power economically to farms is a very difficult one. The individual demands for power are quite small and irregular; also the distances to be traversed are relatively great. In 1921, a provincial Act—the Rural Hydro-

Charges for Light and Power Service in Ontario Municipalities

Municipality	Population	Approx. Transmission Distance in Miles	Average net charge to consumers inclusive of all charges: Residence cents per Kilo-watt-hour	Commercial cents per Kilo-watt-hour	Power Dollars per Horse-power per year
Toronto	512,812	90	2.2	2.8	$21.00
Hamilton	114,766	50	2.1	1.2	13.63
Ottawa	110,708	1	1.6	1.8	13.52
London	59,281	132	1.9	1.7	25.14
Windsor	37,170	248	3.0	3.1	23.78
Brantford	32,786	85	1.8	1.4	19.56
Kitchener	23,027	102	2.4	1.8	16.60
Peterboro	21,790	2	2.9	1.8	15.97
St. Catharines	19,862	9	1.4	1.5	14.56
Guelph	17,922	77	2.7	2.4	14.41
Galt	13,092	93	1.8	2.0	14.45
Niagara Falls	14,805	1	1.6	1.5	13.26

Electric Distribution Act — was passed which recognized both these handicaps and also the desirability, in the general interest, of bringing the benefits of electricity to the farm. It provided a bonus on rural primary lines to the extent of 50 per cent of their cost. This policy has been generally approved; during 1922, approximately 440 miles of rural distribution lines were constructed to give service to over 2,600 consumers, and at present, the rural lines approved by the Commission aggregate over 1,000 miles and gives service to about 14,000 consumers.

Although the aggregate load of the electrical energy thus distributed to rural dwellers is relatively quite small, its influence on the economic life of the Province is already a factor of great importance. The problem of keeping the younger generation on the farm and making farm life attractive is greatly helped and in some cases solved by the coming of electrical service.

Although the Province of Ontario has many water powers distributed throughout its area, nevertheless, the extensive natural storage of the Great Lakes, resulting in the exceptionally uniform flow of the Niagara and St. Lawrence rivers, coupled with their concentrated falls and rapids, and the satisfactory basic engineering conditions for development, make these rivers unique for the furnishing of large quantities of hydro-electricity at low cost.

It should be recognized that along with the development and widespread distribution of electrical energy under co-operative municipal ownership, there has also taken place in various parts of the Province a great development of electrical energy for individual industrial purposes. The favorable provincial legislation, the low rental imposed upon bona fide developers of power, as well as many other factors contribute to facilitate the satisfactory utilization of provincial water powers for the development of new industries.

Power has been extensively used for the development of the pulp and paper industries; similarly, it has contributed to the success of mining operations such as are conducted in the Cobalt, Porcupine, Sudbury, and other districts of northern Ontario. Nickel, silver, gold, iron and other metals as well as many non-metallic minerals are known to exist over extensive areas in Ontario, and water power in the future will no doubt be requisitioned to an increasing extent in this connection.

Those who initiated the plan for the work of the Hydro-Electric Power Commission of Ontario were most particular to protect the operations of the Commission from so-called "politics". That is to say, there was to be no political domination in the appointment of employees, in the purchase of supplies and equipment, or in other matters. It was recognized that such domination or interference inevitably tends towards inefficiency and mismanagement.

The success of the Hydro undertaking would have been impossible without the mutual respect and confidence which have existed among the various municipalities themselves, and between these municipalities and their Commission. On the part of all concerned, there has always been recognition of

the solidarity of the interests involved and it is known that just so long as the necessary respect and confidence are maintained and political influences are eliminated, it will be impossible for any attacks to result in depriving the people of Ontario of the great advantages which they now enjoy as a result of their co-operative effort.

There has been a great deal of unfair opposition to the program of the municipalities in their hydro-electric undertaking, but criticism of the results obtained has come almost entirely from outside sources. Probably no public reform has experienced more misrepresentation than has the work of the Commission.

The many unjust attacks directed against the Commission have usually followed along a well-beaten track. They have consisted of grossly incorrect and misleading statements; the garbling of documentary and other data relating to the Commission's work and employing such garbled material as premises from which to derive conclusions. Pronouncements have been made based upon comparisons so inadequate as to be puerile; pertinent engineering data has been disregarded; comparisons have been made between unlike quantities and involving unlike conditions, so that the comparisons drawn have been useless; considerations of engineering economics have been ignored; and erroneous statements have been made in a most dogmatic manner in the hope of imposing upon the credulity of those not having knowledge of the facts.

By such unjust processes, the work of the Commission has been grossly misrepresented, but in spite of it all the work has prospered beyond all expectation.

No matter where from or how the attacks have originated, they have never come from the over three hundred and fifty municipalities whose citizens know that their own "Hydro" enterprise is a great success—a success of which they are specially reminded every month as they pay their relatively small monthly bills for electrical power and light "at cost".

—Survey Graphic.

Resuscitation Medal Presented To Thomas Hartley, Penetanguishene

ON September 1st., 1923, as previously reported in the Bulletin, Thomas Hartley, a lineman in the employ of the Water and Light Commission of Penetanguishene, successfully resuscitated Adolphe Moreau, who had received a shock from a 550 volt circuit in endeavoring to save a fellow employee who had just received a shock. By his persistent application of the Prone Pressure Method Hartley, after thirty-five minutes' work, was able to save the life of Moreau.

The case of successful resuscitation was reported to the Canadian Electrical Association, and, after being carefully investigated, the executive of the Association approved the award of the Canadian Electrical Association Resus-

Thomas Hartley, decorated by C.E.A. for Successful Resuscitation

citation Medal; this medal being awarded in meritorious cases of successful resuscitation by employees of electrical utilities in Canada.

The arrangements for the presentation were placed in the hands of a Committee, representative of the Town Council, Water and Light Commission and Board of Trade of Penetanguishene. The Committee felt that the opportunity should not be missed to acquaint the school children and public generally with the details of the case and with the method successfully used, and lessons in Accident Prevention and Fire Prevention.

On Friday, April 11th., a meeting for school children was held at 4 p.m., in the Bijou Theatre. Some six hundred school children saw motion pictures dealing with accident and fire prevention, and were given an actual demonstration in resuscitation from electrical shock, drowning and gas asphyxiation.

In the evening a meeting for the Public generally was held. Motion pictures were shown and then Mayor Corbeau took the chair. With the Mayor on the platform were W. T. Dudley, Ex-Mayor of Midland and Ex-chairman and present member of the Public Utilities Commission of Midland, A. W. Murdock, of the Hydro-Electric Power Commission, Thomas Hartley, and Wills Maclachlan, representing P. T. Davies, President of the Canadian Electrical Association.

In his opening remarks, the Mayor called upon Adolphe Moreau, who had been resuscitated to show himself, and invited any who were skeptical to talk the matter over with Mr. Moreau. He then assured the audience how proud the Town of Penetanguishene was of the knowledge and resource of Mr. Hartley. The Chairman then introduced Mr. Maclachlan, who briefly outlined the Accident Prevention work being carried out in Ontario particularly by the Public Utilities which was partly responsible for the extremely low rate charged by the Workmen's Compensation Board for protection. In dealing with the presentation of the medal, Mr. Maclachlan expressed the regret of Mr. Davies in being unable to do so in person. The medal, although of little intrinsic value, is made from copper used in the first high tension line in the British Empire, and serves as a reminder of the fact that knowledge and a clear head can often be the means of saving a man's life.

Thomas Hartley replied in a few words, and was followed by Mr. Dudley, who congratulated the Town of Penetanguishene and Mr. Hartley.

Besides many people from Penetanguishene attending the presentation, there were also representatives of the Public Utilities Commission of Midland, with Manager S. J. Milliken, and representatives of the Bell Telephone Company.

It would not be fitting to leave the subject without pointing out that the training of men in resuscitation and maintaining their efficiency by practice to a large extent depends upon the instructions of those in charge. Too much credit in this direction cannot be given to H. J. Charlebois, Chairman of the Water and Light Commission of Penetanguishene, to Secretary W. R. Parker, and especially to the very retiring but efficient Supt. John W. Irwin.

Association of Municipal Electrical Utilities

Minutes of Meeting of Executive Committee

THE meeting was called to order at 2.30 p.m., on April 11, 1924, at the office of the Hydro-Electric Power Commission of Ontario. Members of the Executive Committee present were—Messrs. J. E. B. Phelps, President; V. S. McIntyre, W. R. Catton, J. E. Skidmore, E. J. Stapleton, J. G. Archibald, O. H. Scott, J. G. Mickler, and S. R. A. Clement, Secretary.

The purpose of the meeting was primarily to consider plans for the Convention of the Association to be held at Niagara Falls on June 26, 27 and 28, 1924.

The executive of the Ontario Municipal Electrical Association having expressed the desire of a delegation from it to meet the executive of this Association for the purpose of arriving at a more complete understanding of the relationship between the two associations, they were invited to attend this executive meeting. Messrs. T. J. Hannigan, W. K. Sanderson and Samuel Carter being in attendance, they outlined the difficulties they were experiencing and suggested remedies for them.

Plans for the summer convention were then taken up.

Mr. V. S. McIntyre, Chairman, Papers Committee presented a report outlining subjects for papers and discussions for the Convention. It was recommended that the papers be circulated by June 4th, and that they would not be read at the Convention but outlined by the speaker and discussed by the Convention members. The suggestions were as follows:—

Thursday, June 26, morning—A paper on a Merchandising subject to be arranged for by Mr. Mickler.

Afternoon—Paper "Analysis of Operating Costs in Hydro Municipal Systems" by G. F. Drewry, H.E.P.C. of Ont.

20 minute discussions on the following:—

"What methods are used for tree trimming?"

"What arrangements are made for guy anchors on private property?"

"When poles are moved, who pays cost?"

"When houses are moved who assumes cost of clearing lines?"

Discussions to be started by R. H. Starr, Orillia.

Friday, June 27, morning.—Paper "Low Power Factor, Causes and Remedy," by C. E. Schwenger, Toronto Hydro-Electric System.

20 minute discussions on the following:—

"Methods of A. C. underground distribution to obviate necessity of transformer installations on city streets."

Discussion to be started by A. J. Magley, Moloney Electric Co., Toronto.

Afternoon—Paper "Induction Regulators, when are these a necessity and where should they be installed?"

by F. F. Ambuhl, Toronto Hydro System.

20 minute question period for the discussion of subjects to be suggested by the members.

The Merchandising section will hold a separate meeting lasting all day on Friday for the purpose of discussing merchandising problems.

It was moved by Mr. V. S. McIntyre and seconded by Mr. O. H. Scott; That the report of the papers committee be adopted. CARRIED.

Mr. W. R. Catton, Chairman, Convention Committee, presented the report of that committee, as follows:—

There will be an Association luncheon at 12.30 p.m. on both June 26th. and 27th., and a Convention dinner at 6 p.m. on the 26th. Major Alex. C. Lewis, M.P.P., Secretary, Canadian Deep Waterways and Power Association, will be the speaker at the luncheon on the 26th., and Mr. Geo. D. Leacock on the 27th. There will also be a speaker at the Convention dinner who will be announced later. Combination tickets will be sold covering the two luncheons and the Convention dinner, at $5.00 per ticket.

Mr. J. E. Teckoe was appointed Chairman of the Hotel sub-committee, which will take charge of allotting rooms to the delegates, and will send out return postcards prior to the Convention re. reservations.

Mr. P. B. Yates has made arrangements for those wishing to play golf during the Convention and those desiring to take advantage of this privilege are to communicate with him.

A Monte Carlo will be held on Friday evening at which special features will be introduced.

On Saturday morning there will be a trip to the Chippawa Power House.

It was moved by Mr. W. R. Catton, and seconded by Mr. J. E. Skidmore; That the report of the Convention Committee be adopted. CARRIED.

The Secretary then reported concerning the replies he had received from the commercial members regarding the advisability of conducting a commercial exhibit. Of the replies he received, 5 were desirous of having an exhibit, 9 reported against, stating they would not take part if one were held and 11 reported against stating they would take part if the majority of the members reported favorably to holding an exhibit.

It was moved by Mr. V. S. McIntyre, and seconded by Mr. W. R. Catton, That no arrangements be made for a commercial exhibit. CARRIED.

A letter from Mr. M. J. McHenry tendering his resignation from the Executive of the Association was presented. This was made necessary by Mr. McHenry's resignation as Manager of the Walkerville Hydro-Electric System, to become Sales Manager of the Ferranti Meter & Transformer Company.

The Treasurer, Mr. G. J. Mickler, reported that he had purchased, with Association funds, 2—$500.00 1934 Victory Bonds, and had placed the same with the bank for safe keeping.

It was moved by Mr. O. H. Scott, and seconded by Mr. G. J. Mickler, That the purchase of bonds by the Treasurer be confirmed. CARRIED.

There being no further business the meeting adjourned at 4.45 p.m.

Regulation of Frequency for Hydro-Electric Systems

By G. O. PHILP

Operating Superintendent, Niagara District, H.E.P.C. of Ontario

Paper read before Toronto Section, A.I.E.E. January 4, 1924

THE only characteristic of an alternating current electric supply that cannot be easily and economically adjusted by the user to suit any requirement, is the frequency.

The maintenance of constant frequency is, of course, entirely a question of the speed regulation of the prime-mover which, if operated at a perfectly constant speed, would supply the System with unvarying frequency. It is, however, impossible to obtain absolutely constant speed, a condition which is only closely approached in the best precision clocks. These maintain a uniform rate with mean daily deviations of 3/100 seconds, which is about the nearest approach to perfect speed regulation possible. The regulation of a large prime-mover is an entirely different matter, although it is of passing interest to notice that synchronous motors are to a limited extent replacing clocks for driving graphic meters in which case the system acts as the regulating clock. The best water wheel governors will easily maintain speed regulation within ¼ of 1% on small changes of load, and will always start to restore the speed to normal if the variation is of this amount. More sensitive governing is possible but cannot generally be used for commercial loads. The operating limits maintained by the Hydro Electric Power Commission and by the Niagara Falls Power Company allow a variation of 1/10 of a cycle either way. This represents very high grade practice and is not approached by many large systems. The momentary speed variations on hydro electric supply are necessarily greater than with steam plants, but the mean frequency over the day is usually more closely maintained. It is intended to cover briefly in this paper, some of the features of the construction of water wheel governors and to outline their limitations and methods of operation.

The general requirements of a water

wheel governor are easily stated but not always met. The governor should maintain constant speed with the unit running idle and should not permit the speed to change more than one-quarter of one percent. The speed at no load should be subject to variation by control at least 5% above or below normal so that there will be no difficulty in synchronizing the unit with the running units under any conditions. The speed regulation over this entire range of variation should be the same as for normal speed. The governor should, when operating on load, start to correct any speed change which exceeds ¼ of 1% of normal. The load carried on the unit should be steady on constant frequency and the governor should not allow any drifting from the setting it is given. That is, if the frequency is constant and several turbines running in parallel are carrying a uniformly divided load of 80% gate opening, the gate opening should not run up on one turbine and down on the others if the governors are satisfactory. The governor should not surge or hunt on load changes, and on constant load should not permit the gates to swing to and fro, a very frequent defect which results in expensive maintenance on the turbine gates and gate operating mechanism. In case of interruption of the total load on the unit, the governor should immediately close the gates and as soon as the speed reaches normal should maintain this speed. The construction of the governor should allow the turbine to be started on governor control and brought up to full speed in a reasonably short time. Once at normal speed the governor should permit the speed of the unit to be regulated by control from the switchboard for synchronizing and when the generator is on the bus should allow any amount of load up to the full capacity of the turbine to be put on in 30 seconds, all of which should be possible without any attention from the governor operator or without any change of adjustments. The adjustments should be permanent once the governor has been installed, provided no changes are made in the general conditions and limitations under which the governor was purchased. It should be possible to adjust the sensibility of the governor so that the speed variation allowable can be altered to meet changed requirements but this adjustment should not be within control of the operator. The drop in the speed curve from no load to full load necessary for parallel operation should be adjustable. The normal speed should also be subject to slight variation. The closing time of the water wheel gates should be subject to change if necessary. The governor should be so constructed that there will be no appreciable wear in any of the parts and there should be no lost motion anywhere. The lubrication scheme should be simple and require a minimum of attention. The assembly should not use any very small or delicate parts and shims or gaskets should not be used. The governor should require practically no maintenance over a long term of years.

All governors are subject to definite limitations which are more exacting in the case of water turbine governors than for steam engines or turbines. The regulation of water turbines,

particularly reaction turbines, requires the use of heavy and powerful mechanisms for the operation of the gates and even in the smallest sizes these forces are altogether beyond the capacity of the governor head. The wicket gates which control the admission of the water to the turbine are often very large and may weigh from a few pounds up to several hundred pounds. The gate levers and other parts will be proportionately designed. The mass of the gates and gate mechanism is then so considerable that it is impossible for it to be moved from the open to the closed position in a very short period of time, during which interval, always several seconds, the speed is changed without control by the governor. The closing of the turbine gates under some conditions during the first part of the movement actually increases the output of the turbine and therefore has an effect opposite to that intended. Where the turbine is supplied from a penstock of any considerable length, the closing of the turbine gates will result in a rise in pressure in the turbine casing and penstock and the maximum allowable pressure rise will limit the minimum closing time for the gates. The closing time may be from 3 to 15 seconds to meet the limits of pressure rise set by hydraulic conditions, and as the speed is changing during this interval, this factor imposes the most important limitation on the governing of the unit and is independent of the governor. The fly-wheel effect of the generator has a marked effect upon the speed rise and in general increased fly-wheel effect will improve the speed regulation. The amount of fly-wheel effect is usually limited by considerations of cost but there is always a minimum below which satisfactory regulation is not to be had. The governor, of course, cannot control the fly-wheel effect and therefore, the speed rise will be independent of the governor on this account. The regulation on load will depend somewhat on the characteristic of the system load. For instance, a lighting load on regulated voltage would give poorer regulation than a load consisting of motor driven centrifugal pumps which would on rejection of part of the load tend to prevent a large rise in speed by the rapidly increasing power requirements of the pumps with a rise in speed. A mixed motor load will have a large fly-wheel effect which tends to limit the speed rise. The fall in speed due to the addition of load to the system is not subject to the same limitations as the speed rise. Hydraulic requirements are not so exacting, and in general the increments of an increasing load are smaller than for decreasing loads which are often quite large as the result of the opening of oil switches cutting off large blocks of load instantaneously. The speed rise guarantees usually given in governor tenders give very little idea of the excellence of the governor since, as mentioned above, for all large load changes they depend on factors beyond the control of the governor which are inherent in the Plant and turbine.

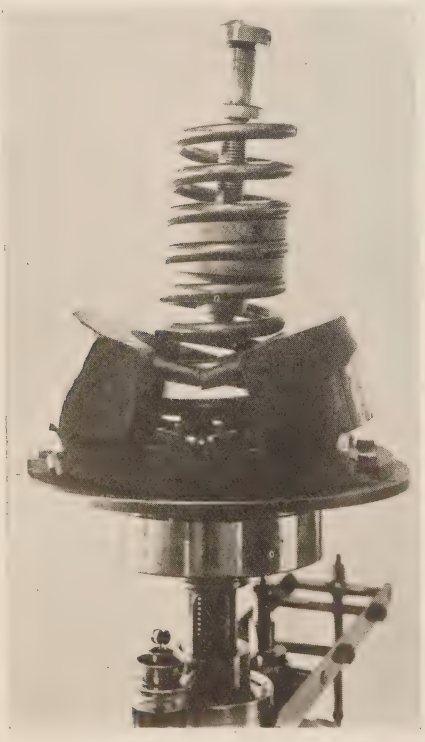
Construction:

All modern water-wheel governors consist of three essential parts; the head which is the speed measuring device, the restoring mechanism which

prevents racing or overtravelling, and the valve to distribute the pressure supply to the servo-motors which move the gates of the turbine. As mentioned before the operation of the turbine gates requires a very considerable force which in all modern systems is supplied through the medium of hydraulic pressure moving the operating pistons in the servo-motor cylinders under control of the governor. The smaller governors are generally entirely self contained and include the servo-motor as well as the pressure supply system with its pump and regulating valves. The largest governors are special units entirely separate from the servo-motors which are usually part of the turbine. The pressure system must be of considerable capacity and is also separate. The governor controls the action of the gates through the servo-motor to which it is connected by suitable piping, often of considerable length where the governor is not located near the turbine. The tendency in recent practice is in favour of building the turbine and governor together as a combined unit although the separation of the governor and turbine is often desirable in many instances. The Queenston Generating Station and the Niagara Falls Power Co. station use governors located at some distance from the turbine.

The most important part of any governor is the centrifugal head which forms the speed measuring device and on which the accuracy and sensitiveness of the governor depends. The original flyball governor invented by Watt, in 1784, is hardly ever used today except to a limited extent in cheap engine work. The development of the governor head from the time of Watt to the present has been slow although the patent records are full of descriptions of various governing devices for which great merit has been claimed but which in practice have been of little value. The Porter governor, consisting of the simple flyballs as in the Watt governor with the addition of a heavy weight attached to the sliding collar which transmits the rise and fall of the flyballs through suitable levers to the control valve, was the first real improvement in governor heads. With minor improvements in mechanical details the Porter governor is still widely used in steam work. It has been used in a few water-wheel governors, none of which are being built in America at present. The development of governors in United States proceeded slowly and while some good inertia governors were brought out for American high speed engines, few notable improvements were made in centrifugal governors. The inertia governor which is generally very powerful has, by reason of its weight and size, found little or no application in hydraulic governors and is not offered by any turbine governor manufacturer at present. The Pickering head has been used extensively in American steam and water wheel governors. This head consists of suitable weights fastened to flat steel springs which have one end fixed and the other end free to move up and down. The fixed end drives the flyballs, which, under the centrifugal force exerted at speed fly out causing the springs which at rest are flat to bow out and thus draw down the movable end which, in turn, operates the valve gear. The tension exerted

by the flat springs may not be sufficient to balance the forces exerted by the fly-balls in which case an auxiliary tension spring is used. The Lombard Governor Company uses this head for all their turbine governors and so does the S. Morgan Smith Company. Both these firms have developed the head so that it is able to give good service. It has not been used in steam practice on any but cheap engines in small sizes. The best modern governor heads were developed in Germany during the last 25 years, particularly in connection with the governing of large gas engines which present special and difficult governing problems. In England a few exceptionally good governor heads



Voith Governor Head, Ontario Power Company

were developed along the same lines as the German productions.

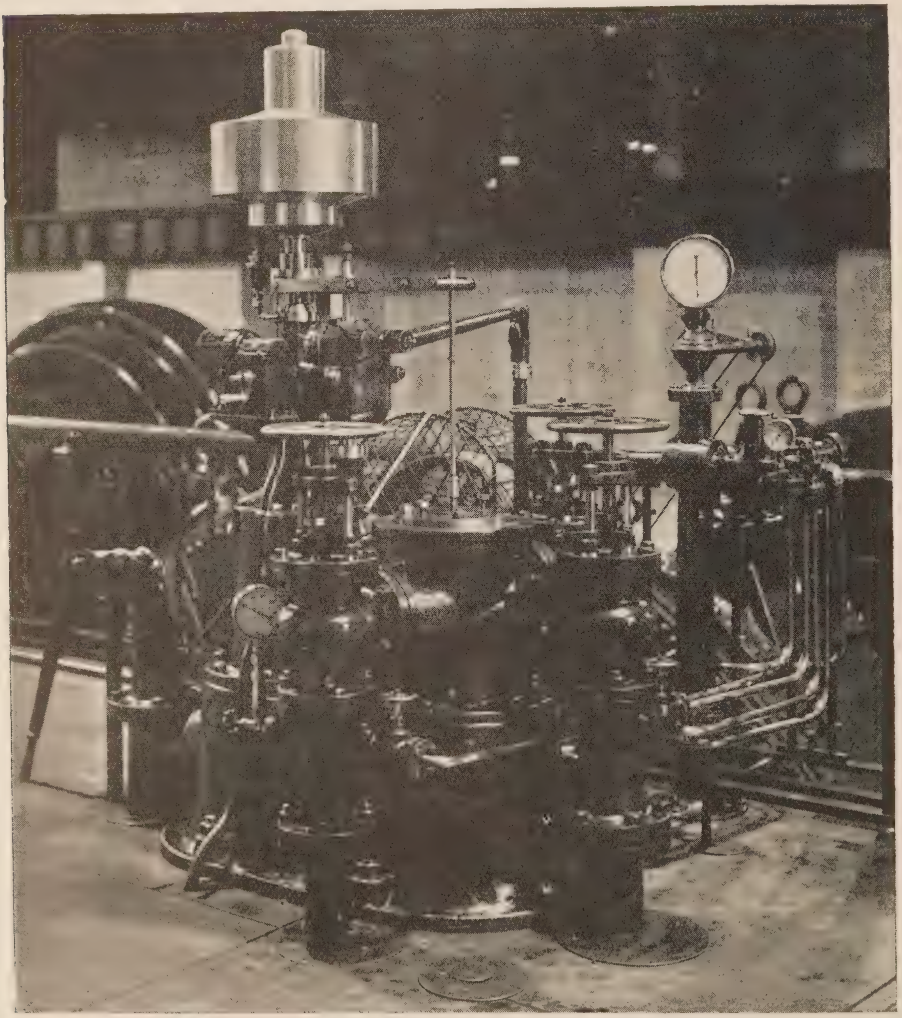
The Porter type governor was sluggish and to be powerful required a very heavy central weight. The objections to this form of governor were surmounted by substituting a cylindrical helical spring for the central weight. The spring with little mass responds instantly to any change in equilibrium between its own tension or compression and the centrifugal force of the revolving balls. One of the earliest forms of this head known as the Beyers governor is still in general use. The chief objection to the first spring loaded heads was that the pins or bearings of the levers connecting the balls and the springs were subject to the centrifugal force of the balls in transmitting this force from the balls to the spring. The resultant friction seriously interfered with the sensitiveness of the head and the later developments were all towards the reduction of friction. The Hartung head avoided friction by arranging the springs and revolving weights so that they directly oppose one another with no intervening joints. The levers or bell cranks transmitted motion only and no stress except the resistance which the valve mechanism might oppose to the governor's action. The Jahns governor, built somewhat on the lines of the Hartung with several new and desirable features appeared in 1903. The Jahns head removed from the levers the friction caused by the effect of gravity acting on the revolving weights by supporting the weights on rollers resting on the lower part of the casing. This head is extensively used in modern water wheel governors and is one

of the best on the market. The Hartung head with improvements in the levers is used by the I.P. Morris Company. The Beyers head, considerably modified, is used by Escher Wyss and Woodward. The Voith governor head is another improvement on the Beyers head which eliminates practically all friction by the use of knife edges in place of pin bearings. The governor used on Westinghouse steam turbines is also of the same type and is very similar to the Voith.

Spring governors act more quickly than weighted governors. The comparison is usually made by saying that the spring governor will pass from one end of its stroke to the other in the same time that the purely weighted or Porter type governor takes in passing over only a fraction of its stroke. Taking the reduced stroke of the weighted governor as S/1, spring governors give for the Beyers, S/2, for the Hartung S/9, and for the Jahns S/15. This means that the latest type of governor will act fifteen times as quickly as a weighted governor, all conditions being equal. The modern spring loaded head is sensitive and quick in action and is free from friction. The governing force is nearly constant throughout the stroke and equal changes of speed produce equal motion at any point of the stroke. These heads are generally powerful and are always fully capable of handling any water turbine governor valves without difficulty. The Voith and I. P. Morris governor heads represent very successful efforts of water wheel governor designers. The Jahns head is equal and probably superior to either of these heads but is somewhat more complicated. The Chorlton-Whitehead, an English head, is another high grade head similar to the Jahns but, unfortunately, not used in this country.

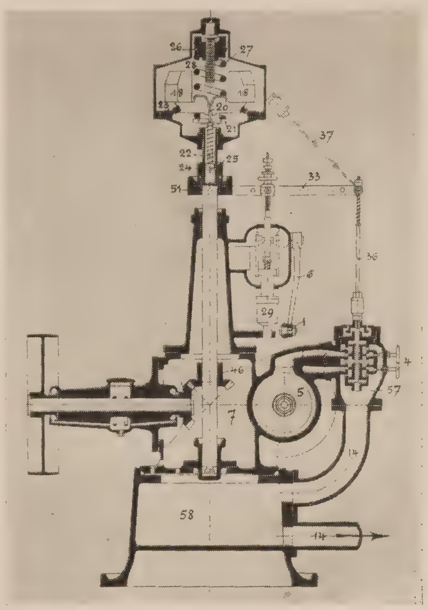
If the speed of a turbine followed a change in gate opening instantly the governing problem would be comparatively simple. However, after a load change with corresponding alteration in speed there is an appreciable time lag in which the gates are moving to the new position and the water column particularly where long penstocks are used requires some time to adjust itself to the new conditions. If, therefore, the governor head had full control of the gates through the relay valve, they would be moved further than necessary on every load change, and would never reach a point of equilibrium if once disturbed. In case loads were dropped the gates would be moved, closed at first and then as the speed fell below normal they would be opened again further than necessary and finally, when the swings were equal to the full gate opening of the turbine, the generator would be tripped out by its relays. Such governing would, naturally, be unsatisfactory and would impose severe and unnecessary strains on the turbine. To avoid this condition, a compensating restoring mechanism is always used. This mechanism operates to stop any movement of the gates by moving the control valve back to neutral position as soon as it is displaced by the governor head and restores the floating lever to its neutral position after a sufficient interval to allow the turbine to return to normal. The theory of the action of compensating mechanisms in relay governing is very complicated and while a solu-

tion has been attempted by Professor Stodola, it involves linear differential equations of the seventh degree and is not very useful in actual practice. The compensating mechanism generally includes a device to give a speed curve sloping from no load to full load so that the full load speed is some 2% to 3% less than at no load. This fluctuation is necessary to give proper division of load between alternators operating in parallel. The scheme used lowers the fulcrum point of the governor lever arm as the turbine gates move open and thus causes the governor head to hold the control valves in neutral at a lower speed. If necessary the governor can be made iso-



Voith Governor, Ontario Power Company.

chronous without at the same time being unstable and the speed can even be increased as the load increases. On water wheel governors of some makes the amount of regulation given the governor by the paralleling device as it is usually called, is adjustable. There is, however, little need for adjustment after satisfactory conditions have once been determined. The method of determining the setting of the paralleling device is quite simple. The unit is operated on a load in parallel with other units at constant speed. The turbine under test is then loaded to full gate opening by operation of the control which is turned from the no load adjustment through several revolutions to a new position which is noted. The load is taken off the turbine and the generator disconnected from the bus and the governor control run up to the position at which it stood while full load was on the wheel. The speed will at this point be somewhat higher than for no load and should if the governor is properly adjusted be about 25.75 cycles if the no load speed is 25 cycles. If the turbine is left entirely to the control of the governor the no load speed will be 25 cycles and the full load speed 24.25 cycles. In practice the speed is readjusted to 25 cycles by control from the switch board as the load comes on so that the final speed is 25 cycles. In case the generator trips off load the speed will be regulated to 25.75 cycles by the governor, following the completion of the governing operations. The setting of the paralleling device on all governors in a Plant should normally be the same if equal division of load between units is desired. Where there is only one unit



Voith Governor, Self Contained Type

18, 20, 21, 23, 26 27—Fly Ball Head
51—Slipping Collar
33—Floating Lever
36—Pilot Valve Stem
5—Servo Motor
46—Bevel Driving Gears
58—Oil Sump
29—Dash Pot
6—Restoring Mechanism

in the Plant the paralleling device will be set to give the same speed at all loads.

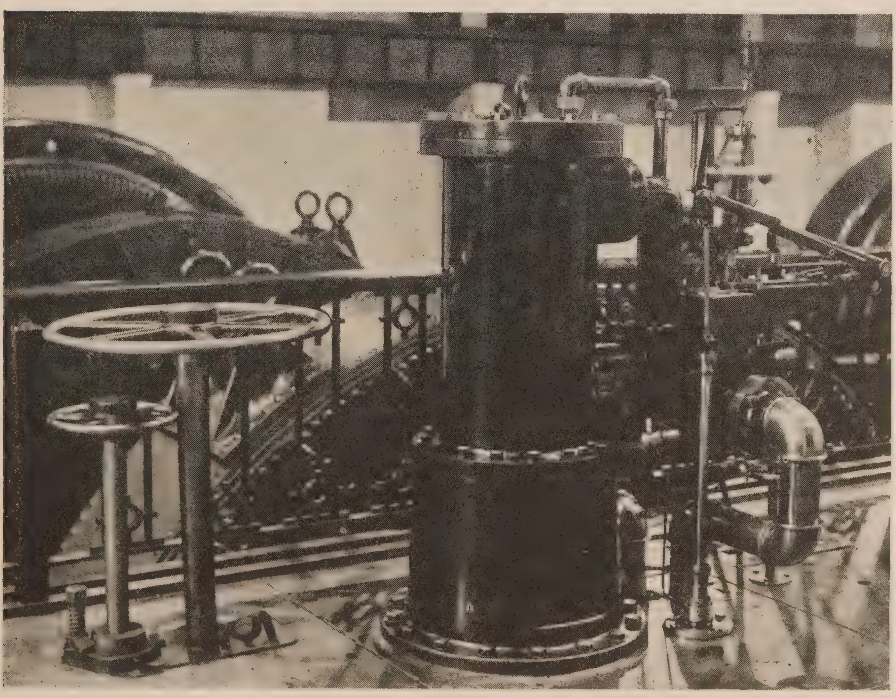
The construction of the governor valves is one of the most important features in any governor. On account of the large quantity of fluid that must be passed through the valves to give the required movement of the servo-motor it is impossible to have the main valve controlled directly by the governor head. The usual practice is to operate the distributing or relay valve through a smaller pilot valve. The pilot valve which is made to be as nearly

frictionless as possible is usually quite small and offers little resistance to the movement of the governor head. The movement of the large relay valve is simultaneous with the motion of the pilot valve if the valves are properly constructed. The Lombard and Woodward governors usually employ a pilot valve entirely separate from the relay valve while in the I. P. Morris, Voith and Allis Chalmers governors the pilot valve moves inside the relay so that any movement of the pilot valve gives a corresponding movement of the relay valve which is automatically stopped as soon as the pilot and relay valve movement is the same. The pilot valve is a balanced piston valve as is the relay valve. It is from ¼ to ¾ of an inch in diameter and is made to fit as closely as possible without friction. This generally means that the clearance around the pilot valve is less than 1/1000 of an inch. The lap on the valve should be small unless it is purposely given a slight oscillating movement as in the case of the Woodward governor. A lap of around 5/1000 inch will give very good results with a steady governor. The relay valve has a comparatively large force available for its movement and is fitted as closely in its cylinder as the pilot valve. The lap is from 10-15 thousandths. The Lombard and other companies have used both pilot and relay valves with saw teeth cut in the edges of the valve which are intended to make the valve more sensitive. They give the same effect as decreased lap and are not necessary if the best workmanship can be had. On very large governors such as those for Queenston Generating Station, the main relay valve is so large that a secondary relay valve is necessary to allow the governor to operate at the speed required. In the Queenston governor the primary control valves are in the actuator located on the generator floor while the main relay valve is on the turbine deck. This arrangement reduced the piping required between the governor and servo-motor. A similar scheme was used in the two 37,500 H.P., I. P. Morris turbines at the Niagara Falls Power Company's plant. The latest 70,000 H.P. turbine at this plant, also built by the I. P. Morris Company, is equipped with a self contained governor with all valves in one casing. The rate of closing of the turbine gates is often regulated by providing stops in the relay valve so that the valve can only uncover part of the port opening to the closing side of the servo-motor, the amount of opening being arranged to suit the requirements. The loading on the turbine is limited in some turbine governors by adjustable stops which limit the travel of the pilot valve and prevent its movement in the opening direction completely as soon as the gate opening has reached the amount at which the limiting device is set. Such attachments are supplied with Lombard and Allis Chalmers governors of certain types. The value of these devices is quite limited in practice.

The connection between the flyballs, restoring mechanism and control valve is called the floating lever. As its name implies, no point on this lever is continuously fixed. The flyball rises and falls with varying speed and the pilot valve moves at the same time. The connection to the restoring mechanism is stationary as long as the gates

are not moving but on movement of the gates moves to restore the pilot valve to neutral position. The position of the floating lever at constant gate opening corresponds to some definite speed at which the flyballs are balanced and the pilot valve is closed. Speed control is obtained by raising or lowering one of the connection points on the floating lever. Usually the restoring mechanism connection is used but it is quite common to vary the length of the pilot valve stem to give the same result. This scheme is used in the Lombard governors. It is objectionable to a certain extent because it complicates the pilot valve and makes possible uncertain elements of friction which may cause the governor to be sluggish. The weight of the necessary gears and other mechanism has to be balanced by the governor head which tends to slow down the action of the head slightly.

The operating fluid for governors is either oil or water under pressure of from 100 pounds to 300 pounds per square inch. Where water is used potassium bichromate or soluble oil is added in sufficient quantity to prevent rusting of the governor parts and to give the fluid some lubricating value. Very few governor manufacturers recommend water for use with their governors and the only real advantage it possesses is that it can be pumped to any pressure by centrifugal pumps. It has been used mostly in large stations using a central pressure supply system.



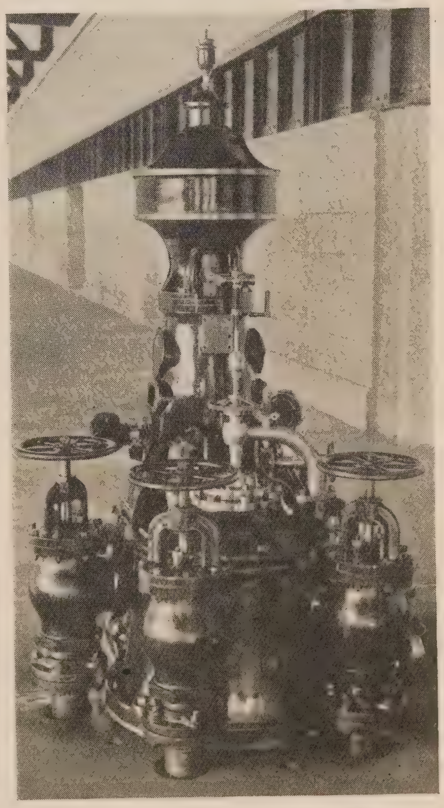
Old Type Lombard Governor, Ontario Power Company

The chief objection to the use of water is its lack of lubricating properties and the impossibility of avoiding sediment in the make up water. Oil pressure systems must be supplied from either plunger or gear pumps. The early oil pressure systems brought out by the Lombard Governor Company used closed piping with the discharge from the governor into a tank in which the pump maintained a vacuum. If the governor required no oil the vacuum tank would be almost entirely emptied into the pressure tank and the pump would run idle. The pumps, of course, drew in air around the packing so that a safety valve on the pressure tank was required to take off the excess pressure. As in all governor systems the pressure tank was run with at least half its volumn filled with air under the operating pressure. When the governor moved the expansion of the air allowed the demand on the system to considerably exceed the continuous output of the pumps. The oil in these closed pressure systems breaks down rapidly and even when the special and expensive oil supplied by the governor manufacturers is used, it must be replaced about every three months. The oil decomposes and deposits tar and other by-products which at the same time attack the governor and pump valves giving rise to excessive charges for maintenance. The European governor builders have from the start used open pressure systems in which the governor discharges into an open sump tank from which the pump suction is supplied. The Lombard Company changed its practice a few years ago so that the closed system is no longer being used except in some of the older plants. It would pay the owners of any such plants to change the governor supply to the open system.

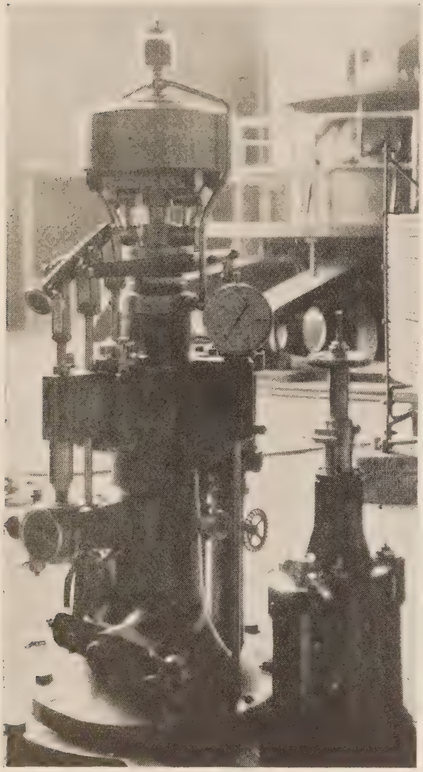
The early stations provided a separate pressure supply system for each governor. Later plants interconnected their governors so that all pumps would be available to maintain the pressure when any demand was made on the system. This was a great improvement over the entirely separated layout and increased reliability of service as well as making it possible to maintain the pumps without having duplicates. This system is used in the Ontario Power Company station and has been so reliable that during the past ten years there has never been a case of trouble due to the failure of governor pressure supply. Where a large number of pumps are used the cost of maintenance may be considerable and to get around this difficulty some of the newer stations use a central pressure supply system in which two or more pumps supply pressure for all governors. This scheme is used in Queenston generating station and the Niagara Falls Power Company station. To be satisfactory the central system must be operated with pumps run by motors fed from separate powerhouse auxiliary units. If the main units are used to supply power for the governing system, trouble on the electrical side of unit may shut down the governor pumps and let the plant get out of control. In both types of system each governor has its individual pressure tank located close to the governor so that the quickest action of the governor may be obtained. The air cushion over the operating fluid in the pressure

tanks is maintained by air valves in the suction of the pumps where individual pumps are used but if a central system is used a special air supply fed from a small air compressor is required.

A somewhat neglected feature of all water wheel governors is the method of drive. Most horizontal turbines drive their governors through belts, and in fact, the drive for the majority of vertical units is of the same type. A few horizontal units have been equipped with silent chain governor drives which are very satisfactory. Unless special attachments are supplied with the governor the breaking of the belt will cause the turbine gates to go wide open, resulting in a runaway if the unit is not on the bus and possibly trouble on the electrical side if the generator is on load. Gear drive for governors has been attempted and is used at the Toronto Power Company plant. The gears are noisy and are somewhat expensive to maintain so that they have not been used extensively and there is no doubt that for the present, belt drives are the most satisfactory form of governor drive yet developed by American hydraulic turbine builders. The Queenston and Niagara Falls Power Company governors are all belt driven. It seems that this is one problem that manufacturers and operators have not given much attention. There is no good reason why governors should not be gear driven. Gears are used in practically all governors on horizontal units which have vertical heads with entire success. The problems of construction successfully met in gear drives for automobiles are much more exacting than in the case of any governor. All steam turbine governors are either direct driven in small sizes or gear driven in the larger units. The Voith Company in Germany was able to build gear driven governors over 15 years ago, but the only American manufacturer to seriously attempt a solution of this problem has been the Allis Chalmers Company which is now building successful governors in which the centrifugal head is carried on the main turbine shaft. Governors of this type are in use at Queenston generating station on the auxiliary units and on one of the 37,500 H.P. units at the Niagara Falls



Lombard Governor as rebuilt by H.E.P.C. of Ont.



Governor and Hand Control Pedestals, Queenston Generating Station

Power Company. There is still room for much improvement in this important feature of governing problems.

Almost all turbines are provided with some form of hand control. In the smaller sizes mechanical control of the gates through powerful handwheels is possible. The largest units with mechanical hand control I have seen are the first three 11,000 H.P. units at the Ontario Power Co. plant which were supplied with a mechanical hand control by the Lombard Governor Co. Two men are needed to handle these machines. The hand control is usually hydraulic and consists of a small control valve which admits pressure to the opening or closing side of the servo-motor in much the same way as the governor proper. Before the hand control valve can be put in operation both sides of the servo-motor must be cut off the governor by closing valves in the pressure lines. The hand control valves are then opened and the unit regulated with the hand control valve. To prevent the turbine getting out of control a restoring mechanism which returns the hand control valve to neutral as the gates move is provided, thus preventing over-travelling during regulation or drifting on steady load. The importance of the hand control in the regulation of the turbine depends somewhat on the governor used. I. P. Morris governors cannot be conveniently used for starting the turbines which are brought up to speed by hand control. The hand control developed by this company is therefore, carefully worked out so that a minimum of work is necessary in changing from hand control to governor control. The valves in the pressure supply lines and in the servo-motor connections are small Johnston valves. They are so arranged that one lever controls the movement of all valves, allowing the transfer from governor to hand control instantly. The separate hand control on Voith governors requires the closing of two large gate valves and the opening of three small valves to put it in operation and is not as quickly available as in the I. P. Morris governor. However, the Voith governor does not require the hand control for starting or other purposes so that it is not as important to have it so convenient as in the case of the I. P. Morris gov-

ernors. The hand controls on the Voith governors in the Ontario Power Co. plant are not used on the average once in five years.

The water wheel governors on the market at the present time represent the development of two different lines of thought. On the one hand the purely governor manufacturing companies, such as the Lombard Governor Company and the Woodward Governor Company have developed governors working on the same general principles as all governors but with complicated mechanisms, generally of light construction, with a large range of possible adjustment. On the other hand the water wheel manufacturers, such as I. P. Morris and Allis Chalmers in U.S., Voith in Germany, and Escher-Wyss in Switzerland, have developed governors which are simple and direct acting with few adjustments or attachments. Both types of governors can be made to give equally satisfactory results, but there can be no doubt that the independent governor manufacturers have yet to build machines which will stand up to the exacting requirements in large stations with the same freedom from adjustment and repairs as the governors built by the turbine manufacturers. Repairs to a governor are always expensive and require fine machine work not easily carried out in the average shop. It is difficult to say just what is the minimum for the maintenance costs of a good governor. Probably the record of the Voith governors at the Ontario Power Company is as good as can reasonably be expected. Eleven of these governors over a period averaging about 12 years' operation each have cost less than $1.00 per year for repairs, and during this same period none of these machines has ever been kept out of service on account of governor trouble.

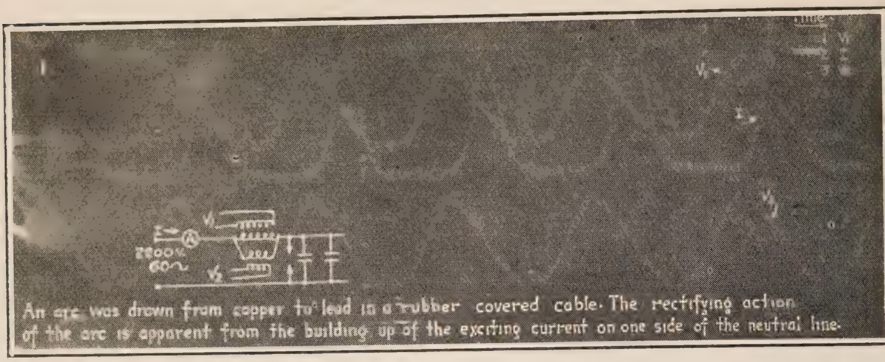
Oscillographic Analysis of Circuit Having An Arc in Series

By W. B. BUCHANAN

Assistant Laboratory Engineer, H.E.P.C. of Ont.

A COMBINATION of apparatus used by one of our engineers in the field where testing facilities were meagre gave some very unexpected results, and in investigating the phenomena by means of artificial circuits in the Laboratory some very interesting combinations of effects were brought to light. As this problem reviews fundamental laws of physics a short description may be of interest if not of actual profit to a much larger number of engineers than those immediately concerned.

The conditions given required that a high potential be applied to a fault in an underground cable, breaking it down from an intermittent arcing ground to a dead-short circuit for the purpose of locating the fault. A 2300 volt supply at 25 cycles and an iron-



An arc was drawn from copper to lead in a rubber covered cable. The rectifying action of the arc is apparent from the building up of the exciting current on one side of the neutral line.

cored reactance in the form of a 5 kw. transformer were the facilities at hand. The Laboratory circuit was made up to duplicate this except that 60 cycle supply was used and the arcing points made adjustable to enable the operator to properly time the operation with the oscillograph.

The diagram shown in the oscillogram print indicates the scheme of connections. Voltage V_1 was taken on the low tension side of the transformer, V_2 on the secondary of a potential transformer and I the exciting current. With the arcing points wide open I was so low as to be negligible; with the points short-circuited the exciting current of the transformer was normal at about 0.25 ampere; under some conditions of arcing I would swing to 5 amperes (r.m.s. value) or more than rated full load current on the transformer.

A study of the attached oscillogram shows that the wave form of the exciting current is not symmetrical. This lack of symmetry is not a constant proportion and further tests also indicate that it is almost if not entirely independent of the effect of the electrostatic capacity of the cable. It does vary, however, with the condition of the arc, e.g. the metals of the electrodes, a critical condition of gas density and the pressure at which the gas is confined.

Hence our conclusion is that the rectifying action of the arc alone is sufficient to bring about the result obtained. An unbalanced component of current flowing in one direction tends to build up a component of flux in one direction and the alternating component in that direction is increased with the results already noted.

Other combinations where similar results might manifest themselves will occur to those familiar with distribution circuits and especially to those engaged in locating faults.

The Use of Mill Type Lamps in the Home

By G. G. COUSINS

Assistant Laboratory Engineer, H.E.P.C. of Ont.

DURING recent years the trend of architecture, furnishing and decoration of the home has been largely toward period styles. This involves the adaptation of modern materials and methods to produce effects that were evolved under quite different conditions.

The electric candle is a good example of this. Electric candles in their proper environment are very beautiful and their popularity does not seem to diminish. The candle is inherently a low-intensity light source and was used when illumination intensities were low as compared to those of our own day.

The proper employment of electric candles under present day conditions is attended with more or less difficulty because of certain opposing features of the lamps used. Small lamps used for low intensity lighting produce objectionable flicker on 25 cycle circuits. Furthermore, the demand for higher intensities than the candle is intended for leads to the use of as high wattage globular lamps as can be installed on an electric candle. The result is often a very top-heavy appearance to the candle unit. This is particularly objectionable when the lamp is unshaded both because of the out-of-proportion appearance of the bare lamp and its cold glaring light.

The mill type lamp possesses some features that render it very valuable for use on electric candles. It is made in 25 and 50 watt sizes in a bulb, nearly globular in shape and of about the same size as the ordinary 25 watt spherical lamp.

The 50-watt size will produce fairly high intensities when required without destroying the appearance of the electric candle as a whole. The 25 watt size should be used when the lower intensity will fulfill the requirements.

All lamps in the living and work rooms of the house should be properly shaded. To produce the desired effect candle lamps should be shaded with shades of glass, silk or parchment of such a color and density as to produce a soft warm glow throughout the room in which they are installed and if the shades are lined with white, a large percentage of light is reflected downward to supply the utilitarian demand. The result is a room the upper portions of which are bathed with low intensity colored light and the lower portions are supplied with a higher intensity to suit the needs of the occupants. By this means the soft effect of the candle is retained while at the same time maintaining good lighting conditions as regards the needs of the eyes.

White paper or tracing cloth are good materials for the lining of shades. They act as reflectors and effectively prevent the light source be-

ing visible through the shade.

Most important of all is the fact that mill type lamps do not flicker as badly as ordinary type lamps of the same wattage. The candle power fluctuation of an ordinary type 25 watt vacuum lamp on 25 cycle circuits is 64% and that of the 25 watt mill type lamp 46%. The decrease in candlepower fluctuation of the 50 watt size is of about the same ratio. The difference, about 18% between the ordinary and the mill type lamps is well worth consideration.

Wall brackets are used principally for decorative purposes and should always be of low brightness through the use of low candlepower lamps or dense shades. The same thing applies to electric candle-sticks or table lamps. Lamps for use in electric candles should always be frosted whether shaded or not. This applies with special emphasis to mill type lamps on account of the greater concentration of the filament which would otherwise produce sharp shadows, which should be avoided.

"Ball Lightning" An Explanation

By E. KILBURN SCOTT, M. Inst. E. E.

FROM time to time one sees in the daily Press, and occasionally in scientific journals, circumstancial accounts by people who say they have seen a ball of fire or globular lightning as it is called. Occasionally the particulars are given in considerable detail by observers who have scientific knowledge, and also by others who are not given to imagining or exaggerating what they see. It seems to me, therefore, that the attitude of pooh-poohing the matter and saying that it is merely an optical illusion is not justified; the accumulation of evidence is much too great for that.

After thinking about the phenomenon a good deal I have come to the conclusion that it can be explained in quite a simple rational way that fits in with well-known chemical and electrical facts. I believe that the ball is concentrated or possibly liquid nitric oxide gas, which has been made by a relatively short flash from a low-lying cloud to earth. Certainly all the observations fit in well with the formation and action of such gas.

We know that when air is passed through an electric arc flame in a large electric furnace the nitrogen and oxygen combine to make nitric oxide gas, which, as it cools down, begins to take up more oxygen and form nitrogen dioxide. The process is quite well known to electrochemists, and in Norway, and elsewhere, plant has been running for many years which aggregates over half a million horse-power and makes nitrates from the air in that way.

We also know that when lightning strikes through the air it makes nitric oxide. That is one of nature's way of fertilising the soil, and it has been estimated that 100 million tons of

nitrogen fixed by lightning flashes fall annually on the earth's surface.

The energy suddenly released by a flash is enormous and the pressure has to be millions of volts so as to tear a way or a hole through the air dielectric. I expect that momentarily a very high pressure is set up, immediately followed by a reaction which gives a sudden chilling effect. If that be so, then the conditions are extremely favourable to the production of a large amount of nitric oxide gas in a very concentrated and probably liquid form.

Lightning is of two kinds, namely, flashes between a cloud and earth, and flashes between clouds. When the first occurs the cloud has first to come relatively close to the ground, and that is why there is darkness just before a storm, also the most violent flashes occur before the rain has had time to lower the tension by discharging it piecemeal by raindrops.

Assuming that highly concentrated or liquid nitric oxide gas is rolled up as it were into a ball by such a lightning flash, then owing to its density it would gravitate slowly downwards in exactly the way that observers say they have seen. Whilst doing so, the outer layer of the gas will be gradually oxidising to nitrogen dioxide, and this will dissipate in the air, and if the length of travel through the air is long enough, it will all disappear in that way. Occasionally, however, the ball of gas starts to fall from a point so near the earth that some of it is still in the form of a ball of concentrated nitric oxide when it arrives at earth level.

If it meets with some organic material, such as a haystack or a tree, which it can nitrate, we know exactly what should happen, because that is one way in which explosives are made. The nitrating and the explosion would take place practically simultaneously, for when nitrogen dioxide comes in contact with organic matter it produces a most violent reaction. One of the worst accidental explosions during the war was caused in just that way.

I have hesitated for some time before putting this theory in the Press, but am encouraged to do so now by its favourable reception by some distinguished friends in the electrical and chemical engineering professions.

—The Electrical Review.

Hydro News Items

Central Ontario System

Extensive improvements and alterations are contemplated in the Oshawa Sub-station. The Low Tension feeders will be routed out of the station underground and additional feeder panels will be installed.

* * *

Work has been started on a heavy program of improvements to the distribution system in Bowmanville to take care of rapidly increasing load.

* * *

The installation of Ornamental Street Lighting in Victoria Park, Belleville, is under consideration.

* * *

The new municipal sub-station in Peterboro is practically completed. The station has been made alive, but is not yet carrying load, as the contractor is still at work on the floors.

* * *

Georgian Bay System

The construction of the extension to the Muskoka Development, which will constitute one of the main generating stations of the Georgian Bay System when completed, has already been undertaken and every effort will be made to have the first of the new units to be installed placed in operation by November or December of the present year. The construction of the transmission line between this development and Waubaushene has also been undertaken and it is expected that the line will be completed before the first unit is ready for operation. Power for construction purposes is being obtained from the Municipal plant at Bracebridge, as the present Muskoka Development is loaded to capacity and is unable to supply any power other than the immediate demands of Huntsville and Gravenhurst.

* * *

Niagara System

Arrangements are being made by Hamilton, London, Kitchener and a number of other larger municipalities for debenture issues to take care of plant extensions during the year 1924.

* * *

It is with regret we learn that Mr. H. H. Couzens is soon to leave Toronto for larger fields whereby the citizens of Toronto are losing a most capable man. The Toronto Hydro Electric System is fortunate in having as assistant manager Mr. E. M. Ashworth, who is to take up Mr. Couzens' responsibilities as manager. We congratulate them both and wish them every success.

Nipissing System

The second unit at the Bingham Chutes Development was placed in operation on March 31st. and the complete output at this location is now available for the Nipissing System.

* * *

Thunder Bay System

The Commission has completed the construction of a transmission line from the original terminus at Bare Point, East of Port Arthur, to the Great Lakes Paper Co., at Fort William, and same was made alive on April 20th. The company expects to be ready to receive power about May 1st., and will require 10,000 H.P. for their initial installation, all of which has been contracted for, and will probably require 15,000 H.P. as soon as the paper mill which is now being arranged for is completed.

* * *

The City of Port Arthur has made application through the Public Utilities Commission for an additional 4,250 H.P., all of which will be required before the close of the present year, and the major portion of same before August 1st. This power is required for the pulp and paper industry and for a new grain elevator.

* * *

The installation of the third and fourth units at the Cameron Falls Development and the transmission line between the development and Port Arthur is progressing favorably. It is expected that No. 3 unit will be placed in operation before the end of May and No. 4 before August 1st. One circuit of the steel tower transmission line will be available for service about October 1st.

* * *

The indications concerning load on the Cameron's Falls development are that the third and fourth units will be loaded to capacity as soon as they can be placed in operation; consequently, the commission has completed arrangements for the installation of the 5th. and 6th. units, as well as the 3rd. transmission line circuit to Port Arthur. This additional work will be carried on with the greatest possible dispatch so that there will be no delay in having the capacity of the complete development available as fast as the load comes on. There is enough load in sight at the present time in the Thunder Bay District to require the full capacity of the six units (75,000 H.P.) within a year after the installation can be completed.

List of Electrical Material, Devices and Fittings

Approved by The Hydro-Electric Power Commission of Ontario in March 1924.

Appliances

The Adams Furniture Co. Limited (Submittor) 211-219 Yonge St., Toronto.

Renfrew Electric Products, Limited, (Mfr.), Renfrew, Ont.

Pressing Irons "Adams Special."

* * *

The Dominion Stove and Foun-

DRY Co., LIMITED, Penetanguishene, Ont.

Washing Machine "Zenith".

* * *

BELLEVILLE ELECTRIC & STAMPINGS LIMITED, 100 Church St., Belleville, Ont.

Electric Flat Irons "Canadian", "Leader".

Electric Toasters "Hurto", "Canadian".

* * *

THE NATIONAL ELECTRIC HEATING Co., LIMITED, 544 Queen St., E., Toronto.

Electric Ranges, Cat. Nos. 422, 423, 424, 426, 428, 430, 435 and 436.

* * *

DOMINION MESSENGER & SIGNAL Co., LIMITED, 10 Wellington St., E., Toronto.

Vibrating Rectifier.

* * *

THE FIDELITY ELECTRIC COMPANY, Lancaster, Pa.

Fractional horsepower Motors.

Watchmakers' and Polishing Motor.

Sewing Machine Motor.

* * *

*THE DOVER MFG. Co., Dover, Ohio.

Flat Irons, "Dover", "Vea", "Domanco No. 4", "A-Best-O", Cat. No. 6½L.

* * *

GENERAL ELECTRIC COMPANY (Mfr.), Schenectady, N.Y.

CANADIAN GENERAL ELECTRIC COMPANY, LIMITED. .. (Submittor), King & Simcoe Sts., Toronto, Ont.

Portable Electric Fans.

"Hotpoint", Electric Ranges, Model Nos. R8P & C, R13P & C, R5P & C, R4P & C, R10, R10P, R11, R11P.

Motors for Portable Machines, Type SA.

"Warren" Clock Motors, Types B-R and B-3R, Cat. Nos. C.G.E. 145 to 168 incl.

* * *

BRUNNER MANUFACTURING COMPANY, Utica, N.Y.

Air Compressors, Model Nos. 932, 939, 949, 969, 965 and 967.

* * *

THE HUGHES OWNES Co. LIMITED, (Submittor), 247 Notre Dame St., W., Montreal, Que.

THE BUCKEYE ENGINE COMPANY, (Mfr.), Salem, Ohio.

Electric Blue Printing Machine.

* * *

H. MAIMIN Co., INC., 251 West 19th. St., New York, N.Y.

Cloth Cutting Machine "Maimin".

* * *

AUTOMOTIVE PRODUCTS COMPANY, LIMITED, 510 King St., E., Toronto.

Automobile Heater for Water Circulating System.

* * *

DOWSWELL LEES & Co., LTD., Hamilton, Ont.

Electric Washing Machine "Laurel".

* * *

*ROHNE ELECTRIC Co., 2434 25th. Ave., S., Minneapolis, Minn.

Glue Heater, Style No. "Sta Warm".

* * *

*AMERICAN ELECTRIC FUSION CORP., 1906, N., Halsted St., Chicago, Ill.

Electric Welding Machines, Type VW.

* * *

Fittings

Tke Canadian General Electric Company, Limited, 224 Wallace Ave., Toronto.

"C.G.E." porcelain base receptacles, Cat. Nos. G.E.694A, G.E.658A, and C.G.E. 139.

* * *

Switches

*Domestic Electric Co., The, (Submittor), Cleveland, O.

Circuit Breaker Switch, Cat. No. 2980.

* * *

*Buffalo Fuse Corporation, 752 Main St., Buffalo, N.Y.

Cartridge Enclosed Fuses, "Pierce". —0-600A, 250V.

* * *

*Betts & Betts Corporation, 645 West 43rd. St., New York, N.Y.

Sign Flashers, "Wynk-A-Lyte", Cat. No. 005-P

Types G; 4-G; LV.

* * *

*Electric Devices Mfg. Co., 814 St. Paul St., Rochester, N.Y.

Automatic Overload Switch "MacGonigal".

*These devices are under the Underwriters' Laboratories re-examination and label service.

In speaking of examining electricians, (or some who claimed that distinction) in days gone by, an examiner has given us some of the ridiculous answers he received to some of the questions. They are given in the following for the satisfaction of our readers:

What is meant by good ground at the transformer?

Packing the earth solid around the pole so that the extra weight of the transformer won't make the pole sag.

What is opposite polarity?

The poles on the other side of the street.

What is voltage drop?

The length of a drop light from the floor.

What is a circuit breaker?

The kind of fuses worked by hand.

What are watts?

The number of cubic feet of electricity passing through a meter.

What is constant potential?

The name of a special meter for measuring regular voltage on arc light wires.

What is a ground detector?

An electric instrument for locating water under ground.

Why do rules prohibit use of trolley current for ordinary light and power?

Because when car is running backwards it makes arc lamps burn upside down and makes the negative wires positive and makes motors on power circuits reverse.

Equipment for Sale

Municipalities desiring the insertion of Notices under this Heading should have Copy of the same reach the Editor by the 10th of the Month of issue.

THE BULLETIN

Published by
HYDRO-ELECTRIC POWER COMMISSION
of Ontario

190 University Avenue
Toronto

Subscription Price $2.00
Per Year

Following The Hydro

By MARTHA BENSLEY BRUERE

ENTERING the Province in the grey dawn, I saw through the car window a little mud-stopped log cabin, old, black, listing to one side, and blazing with light. The power line from Niagara, striding past on giant stilts had dropped a wire casually upon this remnant of a past age and dragged it into the 20th. century.

The large cities — Toronto and Hamilton—have been made just as ruthlessly contemporary; I found their people using the electricity derived from Niagara Falls to operate their homes and their industries at rates which are only a fraction of what we pay. And as a result these cities were clean and prosperous—clean because there was very little soft coal burned and so almost no smoke in the air; but also because every electric device which cleans without dust is in common use. But if the large cities were made so desirable, why should folks stay out of them? Was the answer to this to be found in smaller places?

I went to the city of Woodstock, the perfect flower of the Hydro towns. This has a population of about ten thousand; the foreign inhabitants are six Poles, twelve Chinamen, ten Negroes, and twelve Italians—"if it ain't changed since they was counted last," my driver told me. The town line is hard to identify because the farms blend gradually into the large fields on the outskirts, the large fields edge up against the smaller yards, the little plots of ground crowd up to the short solid row along Main Street. The social life of the town shades out into that of the farms in the same way. I set out to call on four women of whom I knew. One after another, I found them out.

"I could have told you," said my driver. "It's what they call a 'pink tea' or maybe they're playing bridge. Every lady that ain't got a automobile of her own has had a taxi taking her out to Colbert's farm and they ain't coming back till supper time."

Later I saw the Colbert farmhouse. Mammoth silos towered above it with the barns set a little below, the smooth drive curved up to the door with autumn leaves blowing across it and an electric light at the gate to guide the coming and going guest. Obviously

CONTENTS

Vol. XI. No. 5

MAY, 1924

the farmer's wife who lived there was part of the social life of the town.

But on the day of her pink tea I wandered along Main Street and talked with such uninvited males as I could discover. There was the local newspaper office, very trim and shipshape and very, very busy.

He was a brisk man—the editor. He owned a chain of three papers published in three neighboring towns and each community shared in the benefits of the combination news service. Between telephone calls and calls from his staff he told me about his town.

It had no poverty—that is, none that lasted right along. Sometimes a family would be in hard luck for a while and have to be helped out, but they didn't need any charitable institutions. The neighbors looked after what had to be done. He didn't seem to remember much about crime. There wasn't any that you had to keep thinking about. Work? Oh yes—work for everybody all the time. Labor shortage? Maybe somebody might want more workers than they had but then there was usually some farmers' sons or daughters ready to come in for a while. Not many servants in the town. Most women did their own work. They had everything to do it with. But had I seen the factories in Woodstock? No? Well, after I had looked at them I would understand why there was work for everybody.

I told my driver to take me to every factory or manufacturing establishment in the town.

"There's what you would call two factory districts," he told me. "Oh, they're all run by Hydro; we don't have any other kind."

This is the catalogue of the industries of Woodstock in the order that I saw them; a braid and edging mill; a tannery; flour mill; a knit underwear mill; a lumber company which made sewing machine tops and dash boards for automobiles; a machine company; a printing press; a pipe organ company; a piano company—not doing much now because they supply the English trade and "they aren't buying much over there"; another underwear mill; a factory to make concrete mixers; a factory to make farm wagons and dump carts; a paper bag factory; a tapestry mill just taken over by an American firm; a combination lumber company and building contractors; a company making concrete pipes; a green house specializing in chrysanthemums, (this used a good deal of coal in addition to its Hydro); another

organ company; a lumber company making wheels and sleigh runners which, being steamed into shape, required coal in addition to electricity; an establishment which made brass curtain rods; a stove and furnace factory; a dairy and milk bottling plant; a manufactory of seed planters and lawn mowers; a maker of farm wagons and Buster Brown wagons for children; a chopping mill; another knitting mill; a hosiery mill; a candy and biscuit factory. Of these twenty-eight industrial plants, several have been built since the coming of Hydro and more than half have been improved and enlarged. The largest of these establishments of which I got the record employed about two hundred men and women, and the smallest ten. In this diversified collection there was work for men and women, for skilled and unskilled — work seasonal and work steady. It was an incredible number of industries for so small a place—why were they there? First there was no differential against them; power came to them at exactly the same rate as to the manufacturers of Toronto, an absolutely reliable supply—for Niagara runs 365 days a year. Second, they had an intelligent supply of labor which was far more dependable than in the cities, for over 80 per cent. of the town's people owned their homes, and the house owner stays put. People did not have to go away in order to earn a living.

Neither did they have to go away to get an education, for in addition to the rather imposing high school, there was a small college.

And there was a good-sized hospital with a new wing building. They need not go away if they were ill. It was a well balanced town.

I sat in the office of the local druggist, breathing the clean smell of drugs in a perfect blaze of electric light and absorbed more information. He ran on in this way:

Of course they leave the farms around here! They leave the farms everywhere if there isn't enough land to keep them busy. Suppose a farmer has enough land to farm himself or with one son to help him—and then he has four sons! About three of them have got to go away, haven't they? I'm a farmer's son myself; one of my brothers is on my father's farm. We knew of course that some of us would have to go, but it was a mistake to put it up to us that we would have to go to the city. They wouldn't do that now. Folks realize that you can live just as easy on a farm as anywhere else, and if there isn't room for you on your father's place, why, there's all Alberta and Saskatchewan. Plenty of young men from about here go out there for the harvesting—they get big wages and have a chance to see if they like the country. Some of them settle there, or maybe in the States. Of course it's not like our farming, they don't have Hydro.

Do we use Hydro? Of course we do! Our last bill? Average five to six dollars a month, and we have a stove and a grate and all our lights and toaster and an iron and a sweeper and a hot water heater. But we'd have it if it cost twice as much. Why, the stove alone is worth three times the whole bill. Now last Sunday we put the dinner—there was a duck and

things—well, we put it all in the stove before we went to church and didn't think of it again till we were ready to set it on the table. And the way it was cooked! You going to be here next Sunday? If you were I'd ask you down to have one like it. There's no way to roast duck that's up to the electric stove.

It was always like that. I think I could have eaten Hydro cooked food the rest of my natural life—people were so anxious to show me what their equipment would do. It was like showing off a precocious child and much safer.

Last of all I went to the Hydro showrooms where devices for use in the home were exhibited. An old couple who lived on a farm six miles outside the town were considering the relative merits of three electric cook stoves—attracted to one by a light that "burned warningly till all the burners were shut off"; to another by a griddle that got hot quickly; to a third by an oven which held the heat a long time. I left them still undecided and went to the office to see the chief representative of Hydro in the town.

He was at the moment a very busy man. A report was due from him that evening and he was finishing up his records. I gathered just a few facts. Here they are. In the town are 10,300 people. Two thousand homes are served by Hydro. If the families average five people each that means that practically everybody in the town is an electric customer. Four hundred and twenty-five of these two thousand homes use electric cook stoves. For one quarter of the town—it is divided into sections—the records were completed while I was there. This section includes 102 families who cook by electricity. Twenty-five per cent. of these 102 have water heaters in their bath rooms, and all of them have light and most of the small appliances such as sweepers, toasters and electric flat irons. The average monthly consumption of these families was 448 kw. and their average monthly bills were $4.96. And a ton of coal to run a cook stove a month would cost in Woodstock about $15.

I went back to the show room. At first I thought that the same old couple were still studying the stoves, but a second glance showed me another pair of about the same age, and the same speckless respectability, with the same Ford patiently waiting outside.

It seemed to me that in Woodstock the cure of cheap power was pretty effective. Ten thousand people were living together without crowding—living in houses of their own with bits of green around them and a chance for gardens if they chose. They were living in cleanliness and apparent decency. They were living in domestic ease through a plentiful supply of power at low enough rates so that they could use as much of it as they chose. They were living in the practical certainty of work enough for all of them all the time. The eight hour day prevailed and such wages as I was able to get the facts about were fair. For amusement there were two moving picture shows. There was also a social life as witnessed by the bridge party on the neighboring farm. If they left Woodstock for a great city it was not in search of work, or the conveniences of life, or social intercourse—but for

some subtler, more personal, less definite reason—and as a matter of fact they tended to stay.

A town of 10,000 may not be a fair example. But I pursued the problem through a long series of little clean Hydro villages with anywhere from a thousand to three thousand inhabitants: Petrolia, which I approached through a sparse growth of oil well-derricks, where the slow electric pumps were chugging along competently with never a man in sight to supervise them; Watford, with its vine draped wire mill, the home of the fly swatter, though that is only one of its products, where the company stipulated for Hydro and a water system as a condition of keeping their plant in operation; Norwich, with its processions of farmers carting wagon loads of apples to the vinegar mill, and milk to the condensing plant, with the payments on its electric light bonds all provided for and $10,000 in the bank to be used in further betterments, or in a reduction of rates. These and many more like them with electric apparatus to make home life easy, and cheap power to make wage earning certain—towns which are neither growing nor dying but remain small farming and industrial centers.

Intermediate between the villages and the open country stand the hamlets, usually where two township roads cross, a store and a blacksmith's shop, a church with a parsonage, the home of the doctor and two or three houses, sometimes the school—fifty residents at the outside.

"That," said the representative of the Hydro Commission, "is where I first went to tell them about Hydro—that blacksmith's shop. Sat on the anvil which had plenty of time to grow cold while they asked me questions. There was one kerosene lamp and it smoked. Now look at it!"

The place was a blaze of light!

In another hamlet I found myself stopped abruptly in front of an old yellowing brick church. The Hydro representative told me—

When they got Hydro in here they wanted to get it into the church the first thing, so on Saturday I had it connected up. Then on Sunday Sir Adam Beck spoke in the church, and Lady Beck gave the music. Well, what he said was as good a sermon as I ever heard. I don't remember if he used a text or not, but the thing he spoke about was "Let there be light." And there was the Hydro while he talked blazing all over the place.

In another hamlet I found the wife of the physician entertaining four ladies at tea. We played conversational battledore and shuttlecock, between what they wanted to know about the States, and what I wanted to know about Hydro.

"Do you suppose that anybody here would give up Hydro?" I asked as I was leaving.

An old lady stopped her knitting and looked at me severely.

"There ain't none!" she declared.

From the hamlets it's a smooth slide into the farming district—the real Hydro country. We sped along on concrete roads, smooth, wide, following the long roll of the ground like bands of braid sewed on for trimming. Sometimes the poles carrying the wires followed us companionably along, sometimes the great steel towers

marched off independently across the fields. If we were hunting some particularly intelligent farmer the answer to our inquiries was always:

"Follow the Hydro."

And we always found him by following it through.

The Hydro road led us periodically past little square buildings into which wires seemed to plunge and then emerge refreshed for further journeying—transformer stations where the current was "stepped down" for home use. They were about the size of anybody's dining room, and after I had peered into two or three and found them empty, I asked where the men were who ran them.

"Why nobody runs them! They run themselves! Once in a while they are inspected of course, but that's all."

Not much labor power is required to provide the farms of the Hydro country with light—a man to inspect occasionally as balanced against the need to fill hundreds of kerosene lamps and polish smoky chimneys.

I followed the Hydro far out into the country to the home of a dairy farmer. It was late afternoon and his wife in a fresh house dress with her greying hair piled high on her head had leisure to sit and rock and talk with me. The dinner was cooking itself in the electric stove, the electric washing machine was open and drying after the weekly wash.

"Nothing to do by hand but the wrist and collar bands," she told me. "Annie!" she called to her sixteen-year-old daughter. "You better iron out a couple of the boys' shirts. They'll want 'em if we go to the movie after supper."

So Annie placed the ironing board in the doorway where she could talk as she worked, connected the electric iron, and went serenely to work. A back breaking farm washing done and the family gay and ready for a six mile drive to town in the evening! Two little girls ran in from school, and then there were noises from the barn. The cows were coming up. My hostess went to speak to her husband and soon there were sounds of a farmer getting himself cleaned for company. Presently he came in and asked if I wouldn't like to see the milking. They were using three electric machines that night. It is the safest way I've ever seen to milk a cow! In the barn I met two nice sons of going-to-the-city age—but not gone, and with no present intention of going. One of them told me.

"You can milk a good cow almost as quick by hand as you can with a machine if you're a good milker, but you can only milk one at a time! With these, either one of us can do the whole twenty-three about as quick as we could do three by hand—and no hard work about it either!"

Back in the house, I asked if my hostess had an electric sewing machine, and she said "No," she didn't use the machine enough to bother with a motor. It was so cheap to get clothes ready made and they looked better. She didn't like sewing anyway and the mending was as much as she cared to do.

"What are you and your neighbors going to do with the free time Hydro gives you?" I asked her.

She fixed me with a stern, and antagonistic eye. Obviously I had been

tactless.

"Something we like better than house work, I should hope. What do you do"

And that's what I found all through the Hydro country—farmers' wives doing something they like better than house work. In one case a flower garden lovely even in October; in another case singing lessons; again it was visiting about or joining a women's club in the village; sometimes it was just time to rest.

And again I followed the Hydro to the home of a Man who kept Bees. There is a story goes with that man. He had a large rolling farm on which he planted more than his share of apple orchards, and plenty of red clover, and then began on bees. He is one of those rare people whom bees like. He can take them in his bare hands, dip masses of them up like water when they are swarming and they do not sting him—instead they fill his hives with honey and his purse with gold. And his swarms increased so that the blossoms in his orchards and his clover fields were not enough to feed them and he boarded them out with his neighbors. Now, hives set in the orchard mean plenty of bees while the trees are in bloom so that the pollen will be carried to every flower and the trees hang thick with fruit. So the bee man's bees were welcome boarders, and when he gathered the hives up in the autumn they were invited to come again. He laid aside money so that he could leave the farm to his son, and go to town where the mechanics of living would not press so heavily on his ageing wife.

And then one day the representative of the Hydro Commission came down his road and tried to persuade him to sign the twenty year contract which would bring the lines to his house, telling him how much easier the house work would be, and how they could have running water in the house, pumped by Hydro, and light, and an electric stove, and all the things he had expected to get if he moved to town. The Bee Man asked for two days to consider and when the Hydro representative came back he signed the contract.

"You see, we were just about ready to do something very important—we were going to town to live. And I got to thinking about how I was going to miss my old dog that I'd raised from a pup, and how I'd have to come miles if I wanted to pull an apple off that tree by the gate, and the lilacs we'd planted over by the fence, and all the things that had happened in the forty years we'd been married and living in this place, and so we've decided that we'll just take Hydro and retire right here on the farm."

And now he and his wife are still in their own home—"retired". And his son, for whom he has built a house across the road, is running the farm. They have a cold storage plant for their ever-increasing crop of apples, and proper winter quarters for their profitable bees, and the old man and his old wife potter about happily with their old dog and pull the apples from their favorite tree and smell their lilac hedge, and live in a sunset of contentment.

—*Survey Graphic.*

The Sixteenth Annual Report

THE Sixteenth Annual Report of the Hydro-Electric Power Commission is now in the hands of the printers, but will probably not be ready for distribution for some weeks. It will prove interesting reading for all friends of Hydro and shows a broader field of operation and a still more satisfactory financial status than any previous report.

In a general way the report follows the lines of previous issues, and the balance sheet and operating reports will be found in the familiar form in which they have been presented for the past eleven years. There are detailed balance sheets for two hundred and thirty-five municipalities and operating reports for two hundred and twenty-four, an increase for the year of nine and ten respectively. The consolidated balance sheet for all municipalities shows a percentage of net debt to total assets of 64.9 per cent. as against 88 per cent. in 1913. No other figures could show in a more gratifying manner, the solid financial foundation on which the Hydro structure stands.

The Commission's Operating Reports are most gratifying. On the Niagara System, the actual cost of Power was $291,830.56 less than the amount of the interim bills and this has already been rebated to the municipalities. Of the 141 operating municipalities in this system with 289,680 customers there were but eight reporting a total loss of $38,751.89. The net surplus accumulated during the year by the municipalities in this system was $706,499.27 in addition to $786,890.02 depreciation, or a total increase of $786,540.02 as compared with 1922.

All of the smaller systems show satisfactory results. On the Severn System there is but one municipality showing a gross loss of $52.12, while the seventeen with over 8,000 customers operated with a net surplus of $55,900.32 after providing a depreciation reserve of $13,568.00.

The Eugenia System with twenty-four municipalities and 8,825 customers had a net surplus of $32,113.49 after providing $17,417.66 for depreciation. There were but five municipalities on this system showing a total loss of $1,407.93 as against deficits of $3,628.76 in 1922 and $22,-511.05 in 1921.

On the Wasdells System every municipality operated with a profit. The net surplus provided by the 1,577 customers in the eight municipalities being $18,453.99 after setting aside a depreciation reserve of $2,045,00.

The Muskoka System with two municipalities and 972 customers operated with a net surplus of $2,899.-30 in addition to $2,090.00 depreciation; there were no losses.

The St. Lawrence System with ten municipalities and 4,275 customers, show a net surplus of $62,952.60 in addition to $5,816.00 depreciation. There were actual losses in three municipalities aggregating $1,931.01 out of a total revenue of $70,699.61.

The Rideau System with five municipalities and 3,862 customers show a net surplus of $11,519.32 after providing for $7,738.00 depreciation. This surplus is considerably more than

in 1922, largely due to the shortage of water in the winter of 1922-23, which necessitated the operation of auxiliary steam plants at Smith Falls for some time with a consequent material increase in the cost of power.

The Thunder Bay System, which, up to the present time serves only the City of Port Arthur with 4,026 customers operated with a net surplus of $79,555.44 after providing for $7,737.00 depreciation.

The Ottawa System serving the City of Ottawa with 12,719 customers operated with a net surplus of $45,092.34 after providing for $46,726.00 depreciation.

The Trent System consisting of twelve municipalities with 14,088 customers taking power from the Central Ontario System operated with a net surplus of $79,117.29 in addition to $20,993.07 depreciation. One municipality with but two months' operation shows a loss of $51.68.

The summary shows that all Systems operating under cost contracts with a total of 348,028 customers operated with the magnificent surplus of $1,093,753.36 in addition to providing a depreciation reserve of $916,782.75 which is 42.5% improvement over the corresponding figures for 1922.

Eleven Years of Progress

TAKEN as a whole it is doubtful if the citizens of any area of equal size enjoy a greater measure of prosperity and physical comfort than in the Province of Ontario. Individually we complain of the winters as being too cold and too long and of the summers as being too short, though compared with the rigors of the winters in some of the Northwestern States, ours is a semi-tropic, and thousands of our Southern friends have already formed the habit of spending their summer vacations along our glorious lakes and rivers.

We take our advantages as a matter of fact, both those to which we were born and those which have been acquired by ourselves, and among the latter there is probably nothing that has added more to the material prosperity and joy of living than the publicly owned Hydro System; like a healthy tree which grows from year to year ever extending into new fields of usefulness and new area of service.

We have grown accustomed to a monthly or bi-monthly bill for this service that has become so small that it no longer is taken into account in making up our budget and few if any of us take the time to consider or ascertain the heritage which is being provided for those who will follow after us and who, if this heritage is wisely guarded and directed will enjoy service at a cost far below that which we even now consider as negligible.

Just how successful the enterprise has been as a whole is seen from a study of the consolidated balance sheets of all Hydro municipalities operating under cost contracts with the Hydro-Electric Power Commission at the end of 1923 after eleven years of operation.

CONSOLIDATED BALANCE SHEET OF ALL HYDRO MUNICIPALITIES AS AT DECEMBER 31.

	1913	1923	Increase	Per cent.
Number of Municipalities	45	235		
ASSETS				
Plant	$10,081,469.16	$48,428,562.56	$38,347,093.40	380.3
Cash & Securities	450,887.97	2,429,564.53	1,978,676.56	439.0
Accounts Receivable	344,487.95	3,198,769.34	2,854,281.39	828.5
Inventories	540,274.58	1,819,711.62	1,279,437.04	236.8
Sinking Fund & Local Debentures	431,747.27	3,896,261.28	3,464,514.01	802.4
Equity in Hydro System	———	2,929,603.94	2,929,603.94	——
Other Assets	58,959.93	190,071.63	131,111.70	222.4
TOTAL	11,907,826.86	62,892,544.90	50,984,718.04	428.1
LIABILITIES.				
Debenture Balance Accounts Payable & Other Liabilities	10,468,351.79	38,963,826.11	28,495,474.32	272.2
Depreciation Reserve	478,145.88	7,328,858.69	6,850,712.81	1432.8
Equity in Hydro System	———	2,929,603.94	2,929,603.94	——
Debentures Retired	202,751.26	2,852,038.38	2,649,287.12	1306.6
Local Sinking Fund	431,747.27	3,896,261.28	3,464,514.01	802.4
Additional Operating Surplus	326,830.66	6,921,956.50	6,595,125.84	2017.8
TOTAL	11,907,826.86	62,892,544.90	50,984,718.04	428.1
Percentage of Net Debt to Total Assets	88%	64.9%		

It is hardly necessary to enlarge on these figures. They carry their own story with convincing clearness and by a comparison of the percentages of increase in assets and liabilities the financial soundness of the enterprise is apparent. Particular attention is called to the increase in cash securities and other quick assets and to the equity in the Hydro Sinking Fund which the municipalities are acquiring automatically through the cost of power.

Still more interesting is the condensed Operating Report showing the Revenue and Expense Accounts of all Hydro Municipalities operating under cost contracts with the H.E.P.C. in 1913 and 1923, which indicate in a graphic manner almost incredible increases in revenue. In this case also the percentage of increase carries its own story, and attention is again called to the comparatively insignificant part of the total revenue coming from Street Lighting service, and shows how foolish is the claim still made in some quarters, that low

Domestic and Commercial rates are only made possible by excessive charges against the municipalities for Street Lighting.

These figures cover the municipal enterprise only and do not include those municipalities making up Central Ontario, Nipissing and Essex County Systems which are not municipally owned, nor the Rural Power districts which now serve more than 5,000 customers, all of which are operated direct by the H.E.P.C.

CONSOLIDATED COMPARATIVE OPERATING REPORT FOR ALL HYDRO MUNICIPALITIES FOR THE YEARS:—

	1913	1923	Increase	Per cent.
Number of Municipalities	45	235	190	
Number of Consumers	65,707	348,028	282,321	430
REVENUE.				
Domestic Service	$572,154.38	$5,166,452.24	$4,594,297.86	802.9
Commercial Light	525,438.16	3,260,772.50	2,735,334.34	501.6
Commercial Power	905,378.17	5,927,666.37	6,183,886.80	683.1
Municipal Power		1,161,598.60		
Street Lighting	560,929.56	1,269,604.48	708,674.92	126.3
Rural		116,639.06	116,639.06	
Miscellaneous	53,543.24	316,311.21	262,767.97	
TOTAL	2,617,439.51	17,219,044.46	14,601,604.95	557.9
EXPENSES.				
Power Cost	789,632.87	8,699,026.67	7,909,393.80	1001.7
Operation Maintenance and Administration	723,001.32	3,901,739.92	3,178,738.60	439.6
Debenture Charges and Interest	528,549.21	2,607,741.71	2,079,192.50	394.0
TOTAL	2,041,183.40	15,208,508.35	13,167,324.95	645.1
Gross Surplus	576,256.11	2,054,771.91	1,478,515.80	256.6
Depreciation	262,675.24	916,782,75	654,107.51	249.1
Net Surplus	313,580.87	1,093,753.36	780,172.49	248.8

Debt Free Hydro Systems

IN the 1922 Annual Report there was listed an Honour Roll of Hydro Municipalities in which the Quick Assets, such as Cash Securities and Accounts Receivable belonging to the Hydro Utility exceeded in value the total liabilities including the unpaid balance of the Debenture Debt.

The method of Hydro financing and accounting by which the Revenue is required to provide for both the Sinking Fund on the Debentures and a Renewal Reserve is bound to cause a material increase in this list from year to year, but the most ardent of Hydro enthusiasts hardly expected that in one year this list would grow from eighteen to thirty, but such is the case as witnessed by the following list. The figures show the *excess* of Quick Assets over all liabilities.

Municipality	Excess of Quick Assets over all Liabilities.
Ailsa Craig	$ 2.44
Baden	1,852.65
Beachville	5,768.85
Bothwell	3,826.03
Barrie	42,575.48
Coldwater	805.20
Collingwood	27,924.74
Creemore	4,581.08
Dundalk	88.56
Elmvale	1,834.78
Georgetown	2,544.61
Lucan	1,158.86
Mitchell	330.17
Mt. Brydges	87.91
New Toronto	4,364.43
Norwich	3,070.65
Otterville	875.84
Palmerston	4,259.53
Picton	33,726.02
Prescott	5,379.00
Ridgetown	8,643.01
Rockwood	678.12
St. George	2,974.81
Tavistock	2,861.06
Thamesford	359.41
Waterdown	2,292.74
Waterford	5,417.39
West Lorne	1,786.69
Winchester	2,221.42
Zurich	1,069.08

The report also gives an additional list of twenty-three municipalities in which the Excess of Liabilities is so small that it is expected that most or all of them will move up into the above class when the accounts are closed at the end of 1924.

Cheap Power For All

BUSINESS men who have not hitherto examined closely the statement of revenue and expenditure of the Hydro-Electric Commission must have been astonished to learn on what a small revenue so great a business is conducted. On the fourteen systems combined the receipts of the Commission for power supplied totalled $15,742,000, of which the municipalities paid $8,699,000, the balance coming from the export of power to the United States under contracts made by former private com-

panies now incorporated in the Hydro System, and from the sale of large blocks of power directly by the Commission to consumers in Ontario.

The revenue of $15,742,000 met all operating and maintenance charges, and, with the exception of the Thunder Bay System, provided money to meet interest and the renewal and sinking fund payments required by law to the extent of $2,270,000 on a capital investment of $178,960,000.

The sinking fund payments will increase as the periods of exemption from such payments in the case of incomplete or recently completed plants expire, but the revenue from expanding business will be more than sufficient to carry these larger sinking fund payments and to permit of a reduction in the cost per horsepower to the consumers.

Probably nowhere else in the world is there a public or private power system in which so great a capital investment is carried on so small an annual revenue. Service at cost, in the best sense of the phrase, has been provided by the Hydro for almost two-thirds of the people of Ontario. When the Hydro harnesses the St. Lawrence and overtakes the need of the farm we shall have cheap light and power for all.

—*The Globe.*

New Hydro Legislation

IT is proposed herein to give a brief outline of the more important points dealt with in the legislation passed at the recent session of the Ontario Legislature, in respect to the work of the Hydro-Electric Power Commission of Ontario and the Municipal Electric Commissions or Committees.

By the Power Commission Act it is provided that the Hydro-Electric Commission has the powers as to expropriation as conferred upon the Minister of Public Works and to proceed in the manner provided by The Ontario Public Works Act. The section providing this has been amended by the addition of a sub-section outlining those powers as regarding the construction and ownership of works constructed on public highways and streets. Provision is also made covering the changing of the location of works so constructed made necessary by improvements being made to the highway or street.

Amendments have been made in that section of the Act governing townships operating voted areas and rural power districts operated by the Commission. These were necessary to bring the Act into agreement with its intention and also to permit the extension or variation of the limits from time to time according as local conditions should warrant. A similar amendment has been made to that section defining a system, when referring to a group of municipalities served from a common supply, and provision has been made for joining two or more systems into one system. Provision is also made for a township operating a distribution system of itself or under a contract with the Commission changing over to a rural power

district. Upon the formation of a rural power district the township or townships in which it is located may pass a by-law for entering into a contract with the Commission without submitting the same to a vote of the electors.

Provision is made for the inspection and approval by the Commission of the construction, installation and use of all plant, machinery, appliances, fittings, etc., for the generation, transformation, distribution, supply or utilization of electricity in Ontario, except for the mining or treatment of ore or minerals. The Commission may also issue such orders relating to work to be done in the installation, removal, alteration, repair, protection, connection or disconnection of any works as it may deem necessary for the safety of the public or of workmen or for the protection of property.

When a municipal corporation or municipal commission receives electrical power from the Commission, the municipal council or commission is held responsible for the management of the local system as provided in the Act, and penalties are provided for such members who are a party to any act contrary to those provisions.

Arrears for electric service are made a charge against the property and are collectable in the same manner as municipal taxes. The Public Utilities Act has also been amended to make it conform with the ruling regarding arrears.

Amendments have been made to the Hydro-Electric Distribution Act for the purpose of making it conform with the intent of the Act and also of providing for subsidizing secondary construction up to fifty per cent. of its cost.

Annual Meeting of the Eugenia Hydro-Electric Association

THE third annual meeting of the Eugenia Hydro-Electric Association was held in Owen Sound on Monday (May 19th.), representatives from nearly every municipality on the Eugenia System being present.

A meeting of the Executive Committee was held in the morning, after which the various delegates were the guests of the municipality of Owen Sound at a Luncheon in the Dining Room of the Y.M.C.A.

An afternoon session was held in the Owen Sound Council Chamber for the purpose of electing officers for the coming year and the transaction of general business.

Engineers of the Hydro-Electric Commission of Ontario were present at the afternoon session and furnished full and complete information on all matters requested by the Association, particular attention being given to the following:—

(1) Explanation of the recent amalgamation of the Eugenia, Severn, Wasdells and Muskoka Systems into the one system known as "The Georgian Bay System".

(2) The frequency changer station at Mount Forest for receiving

power from the Niagara System.

(3) The interest charges on the capital invested in the system.

(4) Power factor problems.

(5) Range loads and rates.

(6) The general financial condition of the System as shown by the 1923 balance sheet.

Representatives from the municipality of Wiarton, which is not yet served by the Hydro-Electric Power Commission, but which is contemplating such, were present as guests of the Association and the Engineers of the Commission explained for their benefit the methods to be adopted for securing electrical energy through the Commission.

The meeting was perhaps the most successful one so far held by the Association, complete harmony in every respect being the prevailing feature.

That this Association is in complete sympathy with the Commission in its efforts to further the development of power throughout the Province is evidenced by the following resolution which was passed unanimously:—

WE, the Members of the Eugenia Hydro-Electric Association, assembled at Owen Sound in annual session, wish to place ourselves on record as heartily supporting the Ontario Hydro-Electric Power Commission in their endeavor to secure, through the development of the St. Lawrence waterways, a system of power and lighting for Eastern Ontario as we have in the west.

SECONDLY—That we place ourselves on record as supporting their efforts in opposing any encroachment of private power development in this Province.

THIRDLY—That we further support them in their efforts to restrain the City of Chicago in their diversion of the waters of the Great Lakes, and the restoration of this water to its proper channels.

FOURTHLY—That copies of this resolution be sent to Sir Adam Beck, The Hydro-Electric Power Commission of Ontario, the Provincial Secretary, and the Dominion Government.

The following officers were elected for the coming year:—

President: Dr. Roy Hacking, Tara, Ontario.

1st. Vice-President: Mr. John Taylor, Hanover, Ontario.

2nd. Vice-President: Mr. H. Hurdman, Kincardine, Ontario.

Sec.-Treas.: Mr. C. C. Elvidge, Durham, Ontario.

Executive Committee: Dr. Fowler, Teeswater, Ontario; Mr. C. H. Halliday, Chesley, Ontario; Mr. A. Filshie, Durham, Ontario; Mr. J. Parker, Owen Sound, Ontario; Mr. W. H. Gurney, Wingham, Ontario; Mr. Johnson Lucas, Markdale, Ontario; Mr. J. A. Richardson, Grand Valley, Ontario.

Water Power Resources of Canada

The Dominion Water Power Branch of the Department of the Interior of Canada has recently issued its annual report for the fiscal year ending March 31, 1923. This report briefly describes the main lines of activity which are pursued by that organization in investigating the water resources of Canada and administering the Dominion water-powers. Copies of that report will be supplied free of charge on application to the High Commissioner for Canada, Kinnaird House, Pall Mall East, London, or to the Director of Water Power, Ottawa, Canada.

The following is extracted from Bulletin No. 722 recently issued by the Dominion Water Power Branch.—Editor.

WITH an increase during the year 1923 of over a quarter of a million horse-power the total hydraulic power installation of Canada has now reached the imposing total of 3,227,414 h.p. while the growing demand for power is demonstrated by the numerous large developments being rapidly pushed to completion. These new developments are not confined to any particular section of the country but extend from coast to coast and are designed to serve practically every community where a demand for power exists.

While complete data regarding Canada's great water power resources are not yet available a great mass of reasonably accurate as well as considerable specific data is now available in the records of the Dominion Water Power Branch of the Department of the Interior. During the past four years all existing stream flow and power data available from Federal, Provincial and private sources have been systematically collated, re-analysed and co-ordinated with a view to preparing revised estimates of available power based on uniform methods of computation and arrangement.

Basis of Computation.

The figures hereunder are based on definite rapids, falls and power sites, and may be said to represent the minimum water power possibilities of the Dominion.

The power estimates have been calculated on the basis of 24-hour power at 80% efficiency for conditions of "Ordinary Minimum Flow" and "Ordinary Six Months Flow". The "Ordinary Minimum Flow" is based on the averages of the minimum flow for the lowest two consecutive seven day periods in each year, over the period for which records are available. The "Ordinary Six Months Flow" is based upon the continuous power indicated by the flow of the stream for six months in the year. The actual method to determine this flow is to arrange the months of each year according to the day of the lowest flow in each. The lowest of the six high months is taken as the basic month. The average flow of the lowest seven consecutive days in this month determines the maximum for that year. The average of such maximum figures for all years in the period for which data are available is the estimated maximum used in the calculation.

This estimated maximum development is based upon the assumption that it is good commercial practice to develop wheel installation up to an amount, the continued operation of which can be assured during six months of the year, on the assumption that the deficiency in power during the remainder of the year can be profitably provided from storage or by the installation of fuel power plants as auxiliaries. The correctness or otherwise of this assumption for any particular site can only be definitely settled by careful consideration of all circumstances and conditions pertinent to its development. The method, however, enables us to make a fairly satisfactory over-all estimate of the maximum hydraulic power available as distinctive from the estimated ordinary minimum power available.

AVAILABLE AND DEVELOPED TOTALS.

The known available water power in Canada, from all sources and within the limitations outlined, is 18,255,000 h.p. for conditions of ordinary minimum flow and 32,076,000 h.p. under a flow estimated for maximum development, i.e., dependable for at least 6 months of the year.

It is believed that these are conservative estimates since an analysis of the water power plants scattered from coast to coast concerning which complete data are available as to turbine installation and satisfactory information as to stream flow, gives an average machine installation 30% greater than the six-month flow maximum power. Applying this, the figures quoted above, therefore, indicate that the present recorded water power resources of the Dominion will permit of a turbine installation of 41,700,000 h.p.

The total installation to date in waterwheels and turbines through the Dominion is 3,227,414 h.p. In other words the present turbine installation represents only 8 per cent. of the recorded water power resources.

CURRENT PROGRESS.

The sustained, and in many cases increased earning power of existing hydro-electric organizations, both privately and publicly owned, during the past few years of reaction, depression and deflation has been reflected in the excellent treatment of the securities of those concerns on the various financial exchanges and has created a most favorable impression on capital, and generally established a public confidence that is now demonstrating itself in an increasing number of hydro-electric enterprises.

With the passing of the period of abnormally high and uncertain construction costs a general expansion of water power development is taking place. Among the many developments at present under way in the various Provinces of the Dominion may be mentioned the following:

In British Columbia the East Kootenay Power Company is constructing a 15,000 h.p. central electric station, the Granby Consolidated Mining, Smelting and Power Company and The Pacific Mills Limited have added 5,000 h.p. and 6,300 h.p. respectively to their present mining and pulp and paper installations while the British Columbia Electric Railway Company is preparing to install a 25,000 h.p. unit in its Stave Falls station The Manitoba Power Company has installed two units of 28,000 h.p. each in its new

power house at Great Falls, Manitoba, and expect to add a third similar unit this year. The City of Winnipeg also intends adding 3 units totalling 20,700 h.p. to its Point du Bois station. The Hydro-Electric Power Commission of Ontario installed 130,600 h.p. during 1923 bringing its total installation to 746,029 h.p. and expect to have an additional 147,000 h.p. in place before the end of 1924. Power for the mining district of Northern Ontario has been augmented by over 9,000 h.p., a 4,000 h.p. development being completed by the Lower Sturgeon Power Company and a similar station by the Great Northern Power Company, while additional power has been provided in existing stations. Before the end of 1924 an additional 45,000 h.p. is expected to be available from the Quinze River development of the Northern Canada Power Company and the Abitibi River development of the Hollinger Consolidated Gold Mines Limited. In Quebec there has been installed in various central stations some 30,000 h.p. during 1923 and construction work already under way provides for an additional 385,000 by the end of 1924, 280,000 h.p. of which will be in the great power stations of the Quebec Development Company on the Saguenay River and of the St. Maurice Power Company at La Gabelle. The year 1923 has seen substantial additions to existing central electric stations in the Maritime Provinces with further additions promised for 1924.

In summarizing the above figures it may be pointed out that while the total addition to Canada's hydraulic installation during the year 1923 amounted to 255,000 h.p. that there is at the present time actually in process of construction or in active prospect further hydraulic developments amounting to more than 900,000 h.p.

The progress of development is somewhat difficult to follow from year to year because of the magnitude of the operations involved. From three to five years or even longer may elapse between the preliminary surveys and the delivery of power. Again most projects commence with an initial installation much less than the ultimate projected capacity, new power units being added as the load develops.

UTILIZATION OF DEVELOPED WATER POWER.

The 3,227,414 h.p. at present installed in this country may be classified as follows:—

2,411,701 h.p. in central stations for general distribution for all purposes.

497,620 h.p. installed in pulp and paper mills, not including 228,755 h.p. purchased by pulp and paper companies from central stations.

318,093 h.p. installed in industries other than central stations and pulp and paper mills.

The total installation for the Dominion averages 353 h.p. per thousand population, a figure which places Canada third in the per capita utilization of water power among the countries of the world, Norway and Switzerland only having a higher per capita utilization.

WATER POWER IN THE CENTRAL STATION INDUSTRY.

Throughout the Dominion at present there are 282 hydro-electric central stations with an installed turbine capacity of 2,411,701 h.p. or a generator

installation of 1,815,604 kv-a. of which totals 1,644,071 h.p. is installed in commercial or privately owned stations while 767,630 h.p. is installed in municipal or publicly owned stations.

The units vary in size from 10 h.p. to the 55,000 h.p. turbines recently installed in the Queenston development of the Ontario Hydro-Electric Power Commission. The turbine units in the industry average 3,682 h.p. while the average installation of the central stations is 8,552 h.p.

The growth of water power developments in Canada has been striking. Total installed horse power, has grown from 975,000 to 3,227,000 since 1910, central station installation from 605,000 to 2,411,701 h.p. and pulp and paper installation from 191,000 to 498,000 h.p.

There is every reason to believe that this rate of growth will not diminish. New uses for electric current of the greatest import in industrial processes and services are being constantly discovered. Canada's strategic advantage in the location of large reserves of water power within transmission distance of her centres of population should attract special industries to these centres in increasing numbers. Population follows industry and at once an added market is created for power for domestic and municipal uses. All the modern tendencies in the utilization of cheap power indicate that the rate of growth of hydro-electric development in Canada will increase rather than lessen.

The Utilization of Water Power in Relation to Coal Production, Importation & Consumption

The following is extracted from Bulletin No. 736 of the Department of the Interior, Canada, Dominion Water Power Branch. Copies of that Bulletin may be obtained free of charge on application to the Director of Water Power, Ottawa, Canada.—Editor.

THE great majority of all the cities and towns of Canada are dependent upon water power for light, power, street railways and in many cases for water supply, and this situation means that the present social, business and manufacturing life of Canada and its future growth are intimately dependent on our water power and its further development.

It is however in the achieved result of actual saving in coal consumption and in coal importation, that the benefit of water power development to the country can be more definitely and strikingly demonstrated than by any other means. The Dominion Water Power Branch of the Department of the Interior has reviewed this aspect of the situation in an exhaustive manner on several past occasions and it is the intention to briefly summarize in this bulletin the more recent statistics and the conclusions that may be drawn therefrom.

In particular there will be explained the annual coal equivalent of developed water power, i.e., the tons of coal replaced by each horsepower of water power in use; the coal consumption and imports by provinces and the corresponding water power resources and development; the coal necessities of Canada's "Acute Fuel Area" and how enormously these necessities have been diminished by water power development; the strikingly smaller coal consumption per capita in Canada than in the United States in spite of our colder climate; the proportion of water power and fuel power in use, and other related points.

Any such examination establishes indisputably two main points: (1) that the development of water power constitutes the only real and large relief yet achieved to the fuel problem in the Acute Fuel Area and (2) that it is our water power resources and the low average cost of power therefrom that has made possible such rapid development of our manufacturing industries that the net value of product of our factories (deducting duplication) is now greater than that of agriculture.

RELATION OF WATER POWER TO COAL.

The advantages of water power may be briefly summarized thus:—

1. It is a native raw material and industry.
2. It is a non-depletable and inexhaustible source of power and heat.
3. It offers proved certainty as to practical application and financial success.
4. It is the source of power requiring the minimum of labour and there-

fore giving the maximum security against labour troubles.

5. It gives the maximum relief to transportation.
6. With a few local exceptions it is by far the cheapest power available.

The continuous 24 hour power capacity available at minimum stream flow is over 18,000,000 h.p. In practice power is rarely used continuously and the actual capacity is therefore considerably greater. The commercial capacity is estimated at over 32,000,000 h.p. and this would correspond on the basis of present installations to nearly 42,000,000 turbine h.p. installed.

The turbine horsepower installed as at January 1, 1924, was over 3,227,000 h.p. and this represents, with transmission and distribution, a capital investment of over $687,000,000.

This is an important point in the matter of the relation of water power to the coal problem and has received very full study by this Branch. It may be arrived at by two distinct methods—(1) on the basis of the average coal used per horsepower per hour in steam plants, and (2) by analysis of official statistics of coal consumption, population and use of coal in industries.

These two methods give closely similar results, i.e., 9 tons of coal per annum per h.p. installed.

Coal Consumption and Imports in Relation to Water Power.

The total coal consumption in 1923 is the highest on record. However, the consumption in 1922 was the lowest since 1916, due to the shortage of coal caused by the United States strike, and supplies were only maintained by serious depletion of the reserve stocks of dealers, railroads, public utilities, institutions, etc.—the marked rise in 1923 therefore does not represent any special increase in consumption but is probably mainly a renewal of reserve stocks, with in many cases increased reserve against future risks.

The present position may be shown in figures comparing the average coal consumption and imports during the past 5 years with the coal equivalent of the present water power development in tons and value per annum.

Coal:—

Average annual consumption, 1919-1923 32,147,000 tons
Average annual imports, 1919-1923........17,577,000 tons

Water Power:—

Installed h.p. Jan. 1, 1924.....3,227,000
Coal equivalent in tons per annum...................... 29,000,000
Coal value at $10 per ton.$290,000,000

With normal increases in all respects along the lines shown by results over the last 15 years, the coal equivalent of developed water power will equal the total coal consumption about the year 1927—in other words by 1927 Canada will be using only one half the coal she would have required if there had been no water power development.

Coal Output in Relation to Water Power.

It is of interest to consider what degree of relief has been given to the coal situation during the last decade by native coal and by water power respectively, as shown in the following table:—

COAL OUTPUT AND WATER POWER DEVELOPMENT COMPARISON OF INCREASES.

	Coal output Tons	Water Power Installed turbine h.p.	Water Power Coal equivalent in tons
1910	12,909,000	965,000	8,700,000
1911	11,323,000	1,348,000	12,100,000
1912	14,513,000	1,467,000	13,200,000
1913	15,012,000	1,674,000	15,050,000
1914	13,638,000	1,936,000	17,400,000
1915	13,267,000	2,078,000	18,700,000
1916	14,483,000	2,194,000	19,760,000
1917	14,047,000	2,260,000	20,350,000
1918	14,978,000	2,352,000	21,200,000
1919	13,919,000	2,444,000	22,000,000
1920	16,947,000	2,482,000	22,360,000
1921	15,057,000	2,680,000	24,100,000
1922	15,157,000	2,974,000	26,750,000
1923	16,984,000	3,227,000	29,000,000
Increase per cent.	31.5%	235%	235%

It will be seen that, from 1910 to 1923, while the production of native coal has only increased 31.5 per cent. the coal made unnecessary by water power has increased 235 per cent.

In terms of production per head of population, the coal output over that period has been stationary, but the water power development and coal thereby replaced has increased 157 per cent.

In the shorter period since 1920, in spite of the shortage and high prices of imported coal, the coal output has made practically no increase, but the water power development and coal thereby replaced has increased 28 per cent. in the same three years.

It will also be seen that while the coal equivalent of water power was 33 per cent. below the coal output in 1910 by 1923 it had become over 70 per cent. greater than the output.

The Acute Fuel Area.

The foregoing statistics have applied to the Dominion as a whole but the relief afforded to the coal situation by water power development is even more striking when the acute fuel area is considered separately. It is now agreed that this term can only be applied to Ontario and Quebec and that it is the supply of coal to these provinces that constitutes the "fuel problem of Canada". For the moment they may be considered as a unit.

Ontario and Quebec contain over 60 per cent. of the total population of Canada and nearly 80 per cent. of the total manufacturing development. They use over 60 per cent. of the total coal consumption of the Dominion and 93 per cent. of their combined coal con-

sumption is imported from abroad.

In water power these provinces have between 12 and 18 million horsepower available and of this over 2,563,000 h.p. is already developed, this developed water power representing an increase of 215 per cent. since 1910.

The combined coal consumption of Ontario and Quebec for 1923 was 23,810,000 tons; the coal equivalent of developed water power in the same area is over 23,000,000 tons. It will therefore be seen that but for this developed water power, Ontario and Quebec would require about twice their present supply of coal.

It may however be pointed out that had these great industrial provinces been dependent on imported coal for their manufacturing power they could never have attained their present commercial development.

COAL CONSUMPTION PER CAPITA CANADA AND UNITED STATES.

The average coal consumption per capita for all uses of coal from 1918 to 1922 inclusive, on exactly the same basis for each country, was, United States, 5.11 tons, Canada, 3.65 or 29 per cent. less in Canada than in the United States.

In view of the colder average climate of Canada the opposite result might be expected. Analysis shows that this lower consumption in Canada is directly due to the much greater use of water power in industry.

These conditions are fully accounted for by the greater development of water power in Canada than in the United States, as follows:—

The hydraulic horsepower installed per 1,000 of the population is over 350 in Canada to about 100 in the United States or 3½ times as much. Of all the primary power in use in Canada (excluding steam railroads) 70 per cent. is supplied by water power, 30 per cent. by fuel power; in the United States the position is more than reversed.

Power is used in Canada for different purposes in approximately the following proportions:—

	per cent.
Power for all purposes except railways	51
Electric light and domestic use	9
Electric railways	4
Steam railroads. Estimated average h.p. actually used	36
	100

WATER POWER AND MANUFACTURING DEVELOPMENT.

The great bulk of Canadian manufacturing takes place in the acute fuel area, Ontario and Quebec. As before pointed out the marked development achieved in manufacturing in recent years could not have taken place with the handicap of entire reliance on imported coal and this development in manufacturing bears striking evidence to the value of water power to the country.

During the past decade, while the population of the Dominion increased 22 per cent., the use of water power in industry increased 245 per cent. and the capital invested in manufacturing 175 per cent.

Of the total output of Central Electric Stations 97 per cent. is furnished by water power. Of all the primary power in the Dominion, for all purposes except steam railroads,

70 per cent. is furnished by water power.

The value of water power lies in its cheapness, not in a high selling value. For instance with wheat, lumber, pulp, etc. the higher the price the greater the "value of the product" and the greater the value to the country on account of the large export trade, but with water power the lower the price the greater is the assistance to a low cost of production in all other lines of manufacture, for both home consumption and export, and therefore the greater the benefit to the country.

Handling The Public

WHAT does a central-station man mean when he says or writes of "handling the public"? It is a phrase, yes—just a matter of speech—but it seems to indicate a habit of thinking that is out of tune with the very fundamentals of public service. It is another symptom of that dire malady that attacks government and public utility employees and manifests itself in so many ways. It causes the street-car conductor apparently to think that he is herding cattle. It makes the collector of the telephone company forget that subscribers are customers. It affects the girl at the window in the gas office so that she loses her good manners and hurts the feelings of many friends. It so warps the minds of central-station meter readers that they fail to appreciate that they enter these homes of strangers not as masters but as servants. It upsets the perspective of many executives so that they fail to remember that "consumers" are, after all, individuals and citizens with rights and sensibilities equal to their own.

When a stranger calls, or when a friend drops in to speak to any man or woman in home or office, there is never any question as to the way in which the visitor should be received. He is not "handled". He is sure of a greeting and consideration. Why is it, therefore, that when the single stranger becomes one of many, an individual unit in a class relationship, he must lose caste and be called upon to sacrifice so much? Why must he be "handled"?

There is no reason for it—no excuse but that of thoughtlessness. But this thoughtlessness must not be condoned and then become an organization practice and a policy. "Handling the public" is a costly proceeding—and dangerous—and it is well for the fact to be openly considered and frankly discussed from time to time in every central-station organization.

—*Electrical World.*

Electric Delivery

By J. C. BOYERS

General Manager, Ward Motor Vehicle Company

Extract from an Address before a Bakers' Convention

MOST of yesterday I spent with one of the larger bakers of Chicago discussing with him privately what I am going to discuss with you publicly. I asked him what I should say to you. He said, "Why not tell them how I became interested in electrics?" "All right", I said, "how was it?"

"One morning," he replied, "I noticed an advertisement in the newspaper saying that the horse population in our larger cities was rapidly decreasing and the registration of motor vehicles was increasing. (The number of horses in New York City was given as 108,000 for 1917; for 1921, 65,000.) So I began to look around to see who still used horses, and I was impressed by the fact that on some days I hardly saw a horse, and those I did see were mostly used by junk men, milk men and bakers. Then I asked myself how much longer I was going to be permitted to use horses on Chicago streets, and I concluded that it would not be for long. So I started to investigate what to use instead. I found that the more progressive men in the industry were using both gas cars and electrics. This led me to ask why there was the division between these two types of equipment, and I discovered that it costs about twice as much to deliver a hundred pounds of bread with gas cars as it does with electrics. From that time on I was sold on electrics." (The figure he gave me was 35 to 37 cents with electrics and 45 to 80 cents with gas cars).

After my friend had finished, I said, "You then, are convinced that on our city streets Dobbin's day is done?" "Absolutely," said this man.

My first point, then is this: On city streets Dobbin's day is done. Why is this true?

1. The horse and wagon take up too much room on the street. Most cities were not planned; like Topsy, they just grew. There is not enough room for the increasing traffic. Electrics take up less space than horses and wagons and gas cars.

2. Expensive housing facilities must be provided for horses, wagons, grain, hay, bedding, harness, etc. Electrics require one-third to one-half the space, and incidentally they reduce the insurance rate.

3. The mere transportation of food and bedding and offal to feed and bed and garbage the 65.000 horses in greater New York City presents more of a problem than it does to care for the food supply of a city of 65,000 human beings. It is hard enough to keep men on our farms to raise sufficient food for humans. We cannot spare their efforts to raise horse food for city consumption.

4. The horse needs not only a place, but plenty of time in which to sleep. The electric does not get tired.

5. He eats seven days a week whether he works or not. The electric uses power only when in motion.

6. His speed is limited. The average speed of horse-drawn vehicles in New York City is 2.86 miles per hour. He therefore holds up all traffic. Electrics travel from two to four times as fast as horses, but under an absolutely controlled speed.

7. He can go in only one direction effectively. He isn't easy to manoeuvre.

8. His mileage radius is limited. Experienced and humanitarian horsemen all agree that from 15 to 17 miles a day is a horse's limit if worked day in and day out. The electric's practical operating radius is from two to three times that of the horse.

9. The horse needs constantly to be babied. The summer is too hot for him and the winter is too cold and slippery. He gets sick and needs a doctor day or night. He has got to be fed and bedded and groomed and shod and somebody must constantly follow him around and sweep up after him.

10. He is an insanitary member of society. We spend thousands of dollars on swat-the-fly campaigns. Let's swat the source of the fly. No human beings should be called upon to live neighbor to a horse.

11. Take it all in all, he is an economic burden and is fast becoming a public nuisance that may be legislated off our streets before many years have passed. Not long ago I talked with the vice-president of a company in Detroit who owns several hundred horses. I asked him how long he thought they would be allowed to keep them and he replied, "Four or five years at the outside." He is starting to electrify his horse routes.

Dobbin's day is done. He has been a faithful servant of man and deserves our grateful thanks and kind treatment. His passing is not without a pang.

Motorization Seems Desirable, Inevitable.

My second point is this: If the counts against the horse are admitted, then it follows that motorization is desirable and inevitable: Desirable because it relieves congestion, improves sanitation, speeds up the hauling of goods, lengthens the radius of operation, simplifies the housing problem, frees farm land and labor for the production of human food, and reduces the cost of delivery. Inevitable because we have no other alternative.

My third point is this: In looking for a substitute for the horse-drawn vehicle, fundamentally sound economic and sound engineering principles must be observed. Sound engineering insists that the motor vehicle must be mechanically suited to the work which it has to perform. Sound economics dictates that operating and maintenance costs of the substitute must be reasonable.

In general, all delivery work falls into two classes: First, the short haul, frequent stop service. Second, the long haul, infrequent stop service. From 50 to 85 per cent. of city delivery work falls in the class of the short haul, frequent stop service. It is for this kind of work that the electric is designed and is admirably adapted mechanically, and because of this excellent mechanical adaptation, the

operating and maintenance costs are much lower than those of the gas car; in fact, are lower than those of the horse-drawn vehicle for the same service.

At this point, may I emphasize the fact that I am not attempting to establish the claim that the electric truck is the one universal substitute for the horse-drawn vehicle? I am simply pointing out that the gas car has its field of long haul, infrequent stop service, and the electric has its field in the short haul, frequent stop service. These two fields overlap, but they are in no real sense identical. The electric cannot effectively do the work of the gas car, nor can the gas economically do the work of the electric. I am simply trying here to establish the principle that should govern in the selection of delivery equipment. In all probability you will need both gas cars and electrics. To determine the right proportion is the problem.

In order to submit some concrete data on the question of the proportion of the various types of delivery equipment that do actually exist, we sent out a letter to a variety of industries and to a number of companies that we knew used a large number of units. One hundred and twenty-six replies had come in before I left my office. Eighty-four out of the one hundred and twenty-six, or 66-2/3 per cent, had no horses. These one hundred and twenty-six companies owned ten hundred and seventy wagons, sixteen hundred and seventy-four gas cars and seventeen hundred and forty electrics. Five hundred and nineteen of the ten hundred and seventy wagons are owned by four companies out of the total of forty-two companies that still own horse-drawn equipment. One company alone, a large dairy concern, owns more than one-third of all the wagons reported.

Low speed absolutely controlled is a big advantage in controlling costs. Long life and freedom from repairs follow logically as a result of simplicity and low speed. Not long ago I visited the garage of Macy's Department Store in New York. The man who is in charge of their equipment is very proud of its condition. After we had talked for a while he said, "I want to show you our 'old reliable', which is an electric truck that is more than twenty-one years old." Without burdening you with statistics, I shall make the statement which can readily be substantiated by statistics that the average length of life of electric cars in normal service is more than ten years.

Marshall Field & Co., who operate several hundred electrics and many gas cars, have stated: "We estimate the cost of electric cars per day, regardless of mileage, including depreciation, insurance, licenses, etc., as a trifle more than one-half of gasoline trucks."

The Pilgrim Laundry, Brooklyn, which has more than 90 per cent. of its equipment in electric cars, testifies that "Figured on a percentage of gross business (get that—gross business) our trucking costs have fallen from their former 25% to 17%. This 8% saving is sufficient to pay a good dividend on our stock".

May I quote from a letter which was written, not to us, but to an inquirer who sought information from a man in your industry who has operated

all types of delivery equipment over a long period of years. He says: "The question of vehicles for city delivery, so far as the establishment of electric trucks as compared to other vehicles is concerned, needs only unbiased business investigation to substantiate the fact that electric truck service stands far ahead of any other type of service.

"The difficulty with most business enterprises in modernizing their delivery service is the fact that in nine cases out of ten the experiments with electric trucks have been made without proper mechanical supervision. The installation of fleets of ten or more electric trucks, installed with proper housing and expert mechanical and battery supervision, demonstrates very quickly the wisdom of operation of electric trucks through efficiency of service and low cost of maintenance, at a point which offsets profitably the higher cost of installation.

"If you install electric trucks and give them the same expert mechanical attention (and we mean expert electrical, mechanical and battery attention) the results will be more favorably outstanding than any other type of delivery service you have ever used."

—*Baker's Helper.*

"School" Men Take Notice

At a general meeting of the Engineering Alumni Council of the University of Toronto held recently, it was decided to hold a reunion of the Faculty of Science (School of Practical Science) this Fall, nearly two years having elapsed since the last reunion was celebrated.

At a later meeting of the organizing committee, which was the outcome of the decision by the Engineering Alumni, definite arrangements have been decided upon for the reunion to take place on November 7th., 8th. and 9th. "SCHOOL" men please keep this date in mind.

Hydro News Items

Central Ontario System

The new offices of the Kingston Public Utilities Commission were officially opened at 5 p.m. on May 9th. by Sir Adam Beck, who addressed the Commission and visitors. The Kingston Commission is to be congratulated on the beauty and convenience of their new quarters. Sir Adam was the principal guest at a banquet at the Hotel Frontenac in the evening and addressed a public meeting in Memorial Hall, on the power situation in Eastern Ontario. Hon. W. F. Nickle and Dr. A. E. Ross also addressed this meeting.

* * *

The new Municipal Sub-station at Peterboro, built by the Peterboro Public Utilities Commission was thrown open to the public on April 24th., and the Peterboro load has been carried on this station since April 26th.

* * *

The Parks' Board, Belleville, is considering the installation of ornamental lighting in Victoria Park.

* * *

The Picton Public Utilities Commission has requested the Hydro-Electric Power Commission to submit estimates on the cost of ornamental lighting for Main St.

Mr. C. T. Barnes, Local Manager for the Hydro-Electric Power Commission at Oshawa, underwent a serious operation recently. Mr. Barnes' friends on the various systems will be glad to know that the operation was successful and that Mr. Barnes is on the way to recovery.

* * *

Niagara System

The Village of Harrow recently passed Hydro by-laws providing for taking power direct from the Hydro-Electric Power Commission of Ontario, and the purchase of the distribution system in the Municipality. Harrow is one of the Municipalities which is supplied from the Essex County System purchased in 1918 from the Essex County Light & Power Company.

* * *

The Villages of Blyth and Brussels passed the necessary Hydro by-laws sometime ago, and are at the present time constructing distribution systems under the supervision of the engineers of the Commission. It is expected that power service will be available to these Municipalities about July 1st.

* * *

The Village of Humberstone is arranging to submit Hydro by-laws, en-

abling it to become a partner in the Hydro scheme, and to purchase from the Commission the distribution system in the Municipality. The distribution system in Humberstone was constructed by the Ontario Power Company, and has been operated by the Commission since the Ontario Power Company was purchased.

* * *

York Township has recently been divided into a number of Municipalities, and the original York Township is now divided into York Township, North York Township, East York Township and Forest Hill Village. Arrangements are being made to subdivide the power and light distributing system originally owned by York Township and operated by the Toronto Hydro-Electric System. The arrangements will include the supply of power to each Municipality separately from the Hydro-Electric Power Commission of Ontario. The population of the district served in these areas is close to 75,000.

List of Electrical Material, Devices and Fittings

Approved by The Hydro-Electric Power Commission of Ontario in April 1924.

Appliances

Philip Gies Foundry, Kitchener, Ont.

Oil Pumping and Measuring Outfit.

* * *

The Master Electric Company, 1st. & Sears Sts., Dayton, O.

Fractional Horsepower Motors "Master", Types D.M., R.A.

* * *

Clark Dental Manufacturing Co. Limited, 1229 Queen St., W., Toronto, Ont.

Dental Engine Stand.

* * *

G. F. Armstrong, 214 Aberdeen Ave., Hamilton, Ont.

Incubators and Brooders, Cat. Nos. 3, 4 and 5.

* * *

Apex Electrical Manufacturing Co. Limited, 102 Atlantic Ave., Toronto.

Electric Ironing Machine "Rotarex".

Supreme Water Heater Mfg. Co., 1 Carlton Street, Toronto, Ont.

Circulation Water Heaters, Type Nos. B.25, C.25.

* * *

Century Electric Company, St. Louis, Mo.

Portable Motors "Invincible", Type S.P.

Portable Electric Fans "Century".

* * *

National Electric Heating Co. Limited, 544 Queen St., E., Toronto.

Air Heaters, Cat. Nos. 1540, 1545, 1455 to 1459 incl., 1455B to 1459B incl.

* * *

Canadian General Electric Co., Ltd., Hotpoint Works Division, Stratford, Ont.

Ranges "Hotpoint", Model No. R.17.

* * *

*Valley Electric Co. (Mfr.) 3157 S., Kings Highway, St. Louis, Mo.

Canadian Electrical Equipment

Co., (Submittor) 199 Howard Park Ave., Toronto.

Rectifiers, "Valley", Type AB, ABC, KA.

* * *

*AUTOMATIC SHOE SHINER CORP. (Mfr.), 42 East 23rd. St., New York, N.Y.

CANADIAN AUTOMATIC MACHINE Co. (Submittor), 301 Manning Chambers, Queen & Bay Sts., Toronto.

Shoe-cleaning Machine.

* * *

*CLEMENTS MFG. Co., (Mfr.), 601 Fulton St., Chicago, Ill.

THE CLEMENTS MANUFACTURING COMPANY, LTD., (Submittor), 78 Duchess St., Toronto.

Portable Suction Cleaning Machines, "Cadillac", Models 19, 24, 36, 81, 90. "Cadillac" Portable Blower.

* * *

*JEFFERSON ELECTRIC MFG. Co. 426-30 S., Green St., Chicago, Ill.

Toy Transformers, "Little Jeff", "Midget", 25 cycle.

* * *

*HABER DIE & STAMPING Co., Electrical Division, 864 North Ave., Chicago.

Curling Irons, Cat. No. 50/2.

* * *

Switches

SMITH & STONE, LIMITED, Georgetown, Ont.

Snap Switch "S & S", Cat. No. 1401A.

*PLAINVILLE ELECTRICAL PRODUCTS Co., Plainville, Conn.

Panelboards, Type TP.

* * *

Fixtures

F. I. GREEN, 1097 Bay St., Toronto.

Support for Outlet Box for Receptacles.

* * *

*CUTTER Co., GEORGE, South Bend, Ind.

Hangers, Lamp and Fixture. "Cutter".

* * *

Fittings

*HUBBELL, HARVEY, INC. (Mfr.), Bridgeport, Conn.

HARVEY HUBBELL COMPANY OF CANADA LIMITED (Submittor) 7 Labatt Ave., Toronto.

Current Taps (As listed on Underwriters' Laboratories card, dated August 3, 1923).

* * *

BENJAMIN ELECTRIC MFG. Co. OF CANADA, LTD., 11-17 Charlotte St., Toronto.

Fuseless Rosettes, Cat. No. 298A.

* * *

*These devices are under the Underwriters' Laboratories re-examination or label service.

THE BULLETIN

Published by
HYDRO-ELECTRIC POWER COMMISSION
of Ontario

190 University Avenue
Toronto

Subscription Price $2.00
Per Year

Utilization Of Power In The Home

By G. J. Mickler, Sales Dept. and G. F. Drewry, Municipal Dept., H.E.P.C. of Ontario

"DO IT Electrically", "The Electric Home", and "Electrify Your Home", have in comparatively recent years become very common phrases, with more significance in Canada, or parts of Canada at least, than perhaps anywhere else in the world.

It is not a far cry back to the days when the first electric light was introduced into the home, to replace the old smoky oil lamp, or the smelly dangerous gas light. In fact, it is within the memory of the present generation, when the old homestead was wired for electricity and the day on which the first electric light was turned on was one never to be forgotten.

So pronounced an improvement was the common carbon incandescent lamp over the oil or gas lamp that for a long time people were content to burn lamps at the end of drop cords in the centre of the room, without any thought of the possibilities before them in the future development of lamps and lighting generally, and of the proper distribution of light, and also of the uses of electricity for the myriad purposes to which it is applied to-day.

Thus was electricity first introduced in the domestic life of Canada. Following the introduction of the carbon lamp, came the tungsten lamp, which produced almost as great a sensation in the lighting field as did the introduction of electricity at first, because of the greater intensity of light produced with the expenditure of less energy. And now the latest development of the gas filled lamp, with its still greater brilliancy, has made possible the illumination of dark interiors to a degree not far removed from daylight.

Simultaneously with the development of electric lamps, to produce greater lighting efficiency, has been that of the extended use of electricity for many other purposes, resulting in the building up of huge power sources to supply the demand. The result of this development has been the material reduction in the cost of producing and distributing

CONTENTS

Vol. XI. No. 6

JUNE, 1924

electrical energy, permitting a still further use of electricity for all purposes. People are realizing the economies to be effected, the comforts to be enjoyed in properly lighted and properly equipped homes, and are rapidly making the necessary sacrifices to insure the enjoyment of the advantages of completely electrified domains.

The electrification of the home naturally resolves itself into three sub-divisions—Lighting The Home—Equipping The Home With Labor-saving Appliances, and Proper Wiring of The Home. The following pages will be divided into three general subjects, each treated in its own way.

Lighting the Home.

Without delving too deeply into the scientific side of illumination, it can be said that proper lighting contributes more to the attractiveness of a home than is commonly suspected. Such lighting is dependent upon those who provide outlets and fixtures, and upon those who are in a position to enlighten the general public regarding the importance of good lighting in contributing to the welfare and happiness of the occupants of the home.

There are important hygienic aspects of lighting in the home, but the greater possibilities lie in making the home cheerful and attractive. No modern light source should be exposed so as to be normally visible; such a condition is harmful to vision, and contributes much towards making the home unattractive. It is a mistake to have lamps unshaded, creating glare.

Light which falls upon an object to be seen is useful light. A bright light, shining in the eye, is not useful light because it blinds. An unshaded bright light interferes with vision, and will eventually harm the eyes. Investigation of places, which are said to be overlighted, has frequently shown that, if anything, they are greatly underlighted.

A layman often confuses glare with overlight. Tests show that sunlight in an open field measures 8,000 foot candles; in a street between buildings, 3,000 foot candles; shade in a street between buildings measures 300 foot candles; under a tree in the open 500 foot candles. The light on a table next to a south window has an intensity of 110 foot candles; on a table 10 feet from a window, 70 foot candles, and on one 18 feet from a window 50 foot candles. It is interesting to note that the illumination for homes, as generally recommended, seldom exceeds 10 foot candles.

Where lamps can be only partly

shaded from view, they should have diffusing bulbs. Larger lamps with very bright filaments can be used to best advantage in fixtures which shade them completely, and diffuse the light, as in semi-indirect fixtures, or units which combine semi-indirect luminaries with the use of decorative shades. There should also be an adequate number of electric luminaries in every room in the house.

As the various rooms in the house present different lighting problems, they will be treated in brief separately.

Lighting the Livingroom.

The home is the theatre of life. Like a stage, it is a place of various moods and occasions, and the lighting of the living room should be sufficiently flexible to be adaptable to the various activities and social affairs which take place in this room. The activities vary from those of quiet restful occupations, such as reading and studying, to the joyous occasions, when there is company for a Thanksgiving or Christmas celebration.

The provision for only one lighting effect limits the possibilities of illumination and makes monotony. At present there is such a variety in fixtures, and lamps, that a variety of effects can be obtained, if the wiring has been carefully planned. A flood of light is desirable when there is a social occasion, but this does not occur every evening. There are many quiet evenings, when reading and study are in order, so local lighting is best—a table lamp on the study table, or a floor lamp beside an easy chair. While reading at a library table, by means of the illumination from a well-designed table lamp or portable floor lamp, the visual field surrounding the book may be of medium brightness and conditions perhaps will be quite satisfactory. If the remainder of the room is in semi-darkness, the psychological effect is usually conducive to concentrated attention, and the semi-darkness provides a place towards which the eyes may be directed occasionally, for the purpose of resting them.

In addition to portable and table lamps in the living room, many pleasing effects are obtainable by the use of wall brackets, with either tinted or shaded lights, giving the room a restful and artistic appearance, which could not otherwise be obtained.

The Dining Room.

The problem of lighting the dining room is more definite than that of the living room. The table is confined to a fixed position, and it may be taken as the most important spot, and should be the most intensely illuminated object in the room. Certainly there is a cheerfulness about a well illuminated table, hemmed in by semi-darkness.

In lighting the dining room, the so-called semi-indirect unit ordinarily floods the entire room with light, and the table is not the most highly illuminated spot in the room, and is seldom the brightest spot. This semi-indirect lighting is seldom able to fill the requirements for best lighting in the dining room, and is usu-

ally replaced by a modern unit which directs dominant light to the table area. This modern unit may be a shower luminaire, with a number of lamps hanging downward, shaded with long dense glass shades, or a large dome, and just far enough above the table to prevent the light from the unshaded portion of the lamp from shining in the eyes, yet sufficiently high not to interfere with the view across the table.

In large dining rooms, the semi-darkness around the walls is often softly illuminated by the use of shaded and decorated wall bracket lights, with very pleasing effect.

The Bedroom.

The chief light in the bedroom is for completing the toilet; two wall brackets, one on each side of the dresser provide the best solution for this problem. Light from a central fixture does not fill the requirements at the dresser, because the light must illuminate the side of the person which is viewed in the mirror, and this side is usually that facing the wall. Outlets should be provided for decorative lamps, which may be placed on the dresser, and serve a purely ornamental purpose in the absence of wall brackets, but such lamps are seldom high enough, and far enough outside the line of vision to be saitsfactory for making the toilet. A light source of small luminaries, each hid in a dense inverted bowl, provides a pleasing illumination for many occasions in the chamber, and some modern units, in which silk shades may be employed, provide decorative quality, which is welcomed.

It is often desirable to provide for the attachment of reading lamps to the head of the bed for the sick person, or one with an insatiable desire for knowledge, and many decorative units are available for this purpose. Care should be taken to not destroy the artistic effect of other lighting in the room by unattractive lamps of this type.

Halls, Closets and Porches.

The layout of halls and closets make it difficult to give specific information on improving the lighting, but the following hints may be helpful.

Clothes Closets.

To have experienced the inconvenience of selecting garments from clothes closets without sufficient light, reveals the value and convenience of a closet light so placed that it is automatically switched on when the door is opened, or controlled by a pull chain switch, with a radium bead attachment.

Hall.

The appearance of a hall, which is merely lighted by an overhead unit of ordinary type, can be greatly improved by installing an attractive ceiling luminaire, supplemented by well-designed wall brackets. While it is not so essential to have very high illumination in the hall, ornamental brackets and ceiling luminaires help a great deal, and improve the general effect of the average residence hall.

Porch.

The porch should be equipped with decorative ceiling lamps, and have provision for portable lamps. The

modern closed in sun porch is finished like a room, and with adequate wiring and lighting forms one of the most delightful parts of the modern residence. The construction of the lighting in the modern sun porch should be almost like that of the modern living room, because it is virtually the summer living room.

Bathroom.

The best solution of the lighting in the bathroom is to provide a bracket on each side of the mirror. The man who shaves himself will appreciate this, and there are many other reasons for such lighting. In large bathrooms, the addition of a single overhead unit may be necessary, and adds to the general appearance of the room. This unit should be enclosed in an opalescent globe, of attractive design, and in keeping with the fixtures otherwise installed.

Kitchen.

As the average housewife spends a great deal of her time in the kitchen, it is essential and very desirable that the kitchen be one of the best lighted rooms in the home. A well-chosen location for a dwelling provides for proper illumination of the kitchen during the daylight hours, but so often has it been found that this very important provision for properly illuminating the kitchen has been neglected, for other considerations not nearly so important. A great many kitchens must depend for proper illumination on artificial sources. The housewife, to properly attend to the many duties performed in the kitchen, must have adequate lighting at the scene of operations. A light over the kitchen table, and over the sink, properly shaded to prevent glare is most desirable, and this individual lighting can be very effectively augmented by a central kitchen unit placed close to the ceiling, and enclosed in a diffusing globe to prevent the casting of shadows, and distribute the light evenly throughout the room.

Laundry.

The basement is usually one of the neglected parts of the house today, and in equipping the laundry for electricity many essential requirements are often overlooked. The laundry should be provided with sufficient light to illuminate the sections in which the chief operations of the laundry are carried on. If a central lighting unit is installed, it should be so shaded as to light the tubs, washing machine, and the ironing machine, and in large laundries individual lights placed over these various appliances, are very often necessary.

The proper illumination of the laundry is of direct benefit, not only because of the greater ease in performing many laundry duties, but also in the better results obtained in cleansing the family wash.

The stairway leading to the laundry should be adequately lighted, and a pilot light at the head of the basement stairs provided as a reminder that the basement lights have been left on; a convenience made possible in the house which is properly and adequately wired.

Color Lighting.

While it is not intended to delve very deeply into the question of colored lighting, a few essential factors

in this connection may be of value.

In mythology the fact is revealed that color has impressed mankind long before the beginning of written history, and from a study of the primitive races of to-day, it appears safe to conclude that the influence of color upon human organism began in the early stage of the evolution of man. Color is a medium capable of creating pleasure, and this should be a sufficient stimulant to the lighting specialist to inspire him to attempt to utilize its power in lighting. To those who have opened their eyes to the fact that lighting should be considered more from a psychological, than from an engineering standpoint, in nearly all aspects of the field, no plea for utilizing color in light is necessary.

There are certain fundamental effects of various colors upon the human organism, regardless of personality, and these the lighting specialists may utilize for their decorative and artistic effects. In order not to be led too far afield only a few of the most conspicuous colors will be treated.

Red, for instance, is universally considered to be stimulating or exciting. In the lighter tints it becomes mildly stimulating, and rose color, which is a tint of reddish purple is delightfully stimulating in a mild manner. For this reason light of a barely perceptible rose tint, more felt than seen, is appropriate for living rooms and dining rooms on certain occasions, and in ballrooms. Light tints of red, and even red combined with white have been used symbolically to suggest, "Blooming Youth", "Health", and "Happiness".

Yellow, in its warmer hues, and orange, possess the same stimulating characteristics as red, though of a milder degree. It is interesting in this respect to know that shades and tints of yellow are used predominantly in decorating interiors.

Green is most characteristically described as being a neutral color. There is no doubt about this characteristic, and hence shades and tints of green are proper colors for certain interiors.

Blue is a cold color; the degree depending upon its exact hue and purity. When it inclines toward violet it appears to lose this attribute, and becomes restful. Blue is of low luminosity, and being cold is somewhat depressing when used in lighting. However, it may be used to advantage sometimes when it inclines in hue toward green. For example, a living room in mid-summer inclines to be much more comfortable when illuminated by blue or green light.

Purple has scanty application in lighting, though it appears to be characterized by certain attributes and symbolical uses. It has been characterized as dignified, stately, sedate, and pompous, and has long been the garb of Royalty.

White is naturally assumed to be an attribute of Purity, Fidelity, Peace and Friendship. White symbolises "Weakness" — perhaps through association with femininity.

Black naturally is quite opposite in character to white, being char-

acterized as dismal, desolate, deadly, and loathesome. It has its place in lighting effects for low intensity of illumination, or where absence of light in an interior is a potent factor in lighting effects.

Equipping the Home for Labor-saving Appliances.

A great deal has been said about lighting the home, to produce pleasant and artistic surroundings to live in, but a great deal more might be said about the equipping of the home electrically so that living may be really worth while.

The home has been referred to as the theatre of life, and when the curtain rises on a beautiful home, every room presented is complete in every detail, and is usually a model of order and cleanliness; floors are polished; rugs are free from any semblance of litter; and draperies and upholstery are free from dust; linens are as immaculate as the fallen snow, all bearing mute evidence of endless labor and tender care. If the scene is laid in the dining room, the table is set and a banquet prepared ready for the guests. To the untutored, all is produced as though by magic, while in reality, before the curtain was raised the work done behind the scenes of this stage of life is responsible for all that can be seen.

In the olden days, when the many household labors were performed without the aid of modern labor-saving appliances, the housewife's work was never done, and many were the aches and pains caused by wielding the broom, the mop, and the flat iron, and hanging over the old wash tub, and many were the labors unperformed for the want of time and energy, and lack of ambition to do the impossible.

Modern homes of to-day are equipped with electrical appliances of all descriptions, to perform all or any of the duties which one might be called upon to perform in keeping a well-ordered house, as well as appliances for comfort and pleasure. A number of appliances, such as electric vacuum cleaner, the electric floor polisher, and the electric fan, can be used in almost every room in the home. The vacuum cleaner, to remove loose dirt, and dust, and crumbs, and litter from the floors and rugs, as well as the sand and grit imbedded in the roots of the mat, carpets and rugs, which could not otherwise be removed except by dragging the rug outdoors and removing this dirt by strong arm methods. It is doubtful whether any single electrical appliance is so useful and so welcome in the home as is the electric vacuum cleaner, not only for the purpose of cleaning floors and rugs, but also taking care of the problem of dusting and renovating draperies and upholstery.

The electric floor polisher, while not so universally adaptable, fills a long felt want in keeping polished floors in condition. In many homes to-day the old pine floor has been abandoned for the more sanitary and artistic hardwood floor, which requires constant attention.

The electric fan, whose main function in summer is cool comfort, has a number of other uses, which make it a very useful appliance. It

can be used for drying clothes indoors; drawing cool air into the bedroom; drying fruit and vegetables; increasing the efficiency of the furnace; drying dishes; increasing the heat radiation of a radiator, and exhausting the odors in the kitchen. Other appliances, more or less restricted in the applications may be grouped under the headings of the rooms in which they are generally found.

In the living room of the modern home, the electric log, or fireplace, means a clean hearth, no ashes to be brushed up and removed; no fuel box to be filled, and no fire screen to prevent sparks from injuring the rugs. In short, electric heat in the fireplace is clean heat, sootless and smokeless, free from fumes and fine ash dust.

Good music is also essential in the modern living room, and it is made possible through the electric player piano, and electric phonograph.

Where provision for a grate or a log does not exist the portable electric heater is found very useful on chilly days, when the furnace is out, or in the long cold wintry days, when the furnace is taxed beyond capacity.

When the new home is built, and the family begin to live in it, the small conveniences, apparently so insignificant when planned, become the vital means of family comfort. This is especially true as revealed in the presence or absence of means for using appliances in the dining room. The possibility of preparing a light meal, breakfast, luncheon or Sunday afternoon supper at the table, affords real satisfaction when help is not available, and the more self-serving it can be made, when there is no maid, the better it is for the comfort and convenience of the entire family. The electric toaster, grill, teapot, percolator, waffle iron, chafing dish, and egg boiler, are among the appliances frequently used in this sort of dining room service.

Electrical appliances for the bedroom and the bathroom are chiefly the personal use devices, such as the beautifiers, the curling iron, violet ray, and the electric vibrator, as well as the electric fan, and hair dryer, not to mention the immersion heater for the shaving mug, or the milk warmer.

The electric warming pad is rapidly replacing the old hot water bottle, being far more satisfactory because of its continuous even heat, and its capability of heat adjustment to any desired degree; and a small radiant heater is an accessory found very useful to kill the chill in the bedroom on a cold morning. It can be moved from room to room as required, when the children are dressing. The wall heater in the bathroom is gradually taking the place of the radiator, or the warm air register, because the bathroom small as it is, does not require to be constantly heated to be comfortable.

In the sun porch, which is usually a combination sewing room, reading room, or nursery, such appliances as

the electric sewing machine, electric heating pad, the portable heater, electric fan, and many types of electric toys, occupy a prominent place in the equipment of the room.

Afternoon tea can be prepared in the sun room on the tea wagon, with the aid of the percolator, toaster and the grill, without interfering with the gossip or bridge.

The kitchen is the woman's work shop, and the average housewife spends a large portion of her toiling hours over the kitchen stove, sink and the table. All electric conveniences that lessen the labors of the modern housewife, remove the drudgery of preparing meals, dish-washing, and many other things she has to perform, go a long way toward maintaining peace and harmony in the family, and preserving the youth and charm of the "Rulers of the World."

In the electric range, we have an appliance that does much to accomplish what we desire. One of the special features of an electric range is better cooking results. We all know the result of better cooking. The even regulated heat eliminates guesswork, and supplies in its place an accuracy not hitherto possible with other fuels. The electric oven, free from gases that contaminate the food and form air currents that carry off fine flavors, produces excellent results. The meats are juicier, and richer; bread is moister and keeps longer; cakes are more delightful in flavor, and biscuits are beautifully browned. The same heat that produces good results at one time can be duplicated every time.

The advantages of the use of electric ranges may be summed up as follows:

Electric cooking saves time ordinarily spent in watching food cook—valuable time that can be used in better ways outside the kitchen. And in an electric range none of the heat is wasted, for it is concentrated directly on the food itself.

Electric cooking is more comfortable because it prevents an over-heated kitchen. It is more healthful because it removes from the house the odors of burnt fats, and tainted air robbed of vital oxygen. It is more economical because rich juices of meats are saved, and not lost through evaporation. It is possible to buy small roasts because so much nutrition is saved.

The electric range in the kitchen means that the kitchen walls seldom have to be renewed and cleaned. It does away with much of the cleaning otherwise so necessary. It helps to solve the servant problem, for if the home-maker is left without help, the electric range, with its insulated oven, is the best helper she can have, and the cooking of meals is simplified because time and strength are saved.

In the electric dishwasher, we have another appliance, which, when it becomes properly established and reasonable in price, will be the most popular of all appliances in the home, because of its great utility.

The average family of four uses about 50,000 dishes in a year's time, and it takes about eighty-four—eight-hour days to wash them, which is almost incredible, yet it is true that in the average home the housewife spends practically one-quarter of her time washing dishes.

In the days when irons had to be heated on top of the hot stove, ironing day, especially in the summer time, was one of the most dreaded in the common household. To stand from morning till night close by a hot stove, putting the irons on and off and pushing the old iron over the family laundry, certainly took the vim and vitality out of the "fair sex." The introduction of the electric iron into the family kitchen or laundry was perhaps the greatest boon that has ever befallen womankind. The home without an electric iron in Canada, where electric current is available, is almost unknown.

These three devices comprise the most important electrical appliances to be found in the modern kitchen, and the most frequently used, although it is not uncommon to find electric refrigerators, electric fans, to exhaust the cooking odors in the kitchen, electric percolators, toasters, utility motors, for polishing and grinding cutlery, among the appliances of many modern homes.

In the family laundry, located in the basement of the most modern homes, other electrical appliances, and almost the most useful, lighten the labors of the "lady of the house." The electric washer, which has displaced the old wash board, the wooden tub and the boiler, does the family wash with hardly any attention. Other housework can be done while the washer is performing its duty, and the backaches, and ugly tempers of the old-time wash day are fast becoming things of the past. Here too, the servant problem which is becoming acute in many communities finds a solution to most of its difficulties.

The ironing machine is rapidly taking the place of the electric iron, and in many cases dispensing with the services of a laundress. Modern ironing machines take care of 95% of the laundry.

The electric clothes dryer, in city dwellings where backyard space is limited, and unfit for drying clothes, is being used quite extensively.

The modern laundry is also equipped with an electric fan, electric water heater, and generally an electric iron.

In some parts of Canada rates for electric current are exceedingly low, so much so, that practically all electrical appliances can be operated at a comparatively low cost, and it is not uncommon to find electric bills showing a consumption of from 300 to 1000 kw-hr. per month, ranging from $3 to $10 per month as a minimum or from $5 to $20 as a maximum. Table No. 1 is prepared to show to what extent all appliances can be used for the small sum of 9c net.

9c Will Operate	Capacity	At 1c per kw-hr.	At 2c per kw-hr.	At 3c per kw-hr.	At 5c per kw-hr.
Curling Iron	20 W.	500 Hr.	250 Hr.	167 Hr.	100 Hr.
Warming Pad	40 W.	250 Hr.	125 Hr.	83 Hr.	50 Hr.
Sewing Machine	60 W.	166 Hr.	83 Hr.	55 Hr.	33 Hr.
Vibrator	60 W.	166 Hr.	83 Hr.	55 Hr.	33 Hr.
Vacuum Cleaner	100 W.	100 Hr.	50 Hr.	33 Hr.	20 Hr.
Washer	200 W.	50 Hr.	25 Hr.	17 Hr.	10 Hr.
Percolator	400 W.	25 Hr.	13 Hr.	8 Hr.	3 Hr.
Hair Dryer	440 W.	12 Hr.	11 Hr.	7 Hr.	4½ Hr.
Toaster	550 W.	18 Hr.	9 Hr.	6 Hr.	4 Hr.
Iron	660 W.	15 Hr.	7 Hr.	5 Hr.	3 Hr.
Air Heater	660 W.	15 Hr.	7 Hr.	5 Hr.	3 Hr.
Grill	660 W.	15 Hr.	7 Hr.	5 Hr.	3 Hr.
Water Heater	1000 W.	10 Hr.	5 Hr.	3 Hr.	2 Hr.
Grate	2000 W.	5 Hr.	2½ Hr.	1 Hr.	1 Hr.
Range	3000 W.	3 Hr.	1½ Hr.	1 Hr.	¾ Hr.
Ironing Machine	3000 W.	3 Hr.	1½ Hr.	1 Hr.	¾ Hr.

Table No. 1—Extent to which appliances can be used for the sum of 9c. net.

Popularity of Electric Appliances.

While no survey has ever been made of the number of appliances in use in any or all communities, it is safe to assume that with a great many appliances at least, the point of saturation is being approached very rapidly. A survey recently made of the number of electric ranges in use in some of the larger communities in Ontario is shown in Table No. 2.

It is safe to say that the more popular appliances, such as the iron, toaster, grill, vacuum cleaner, washing machine, and the electric fan, will show much higher percentages than do the ranges in all of these communities, were the figures available for the purpose.

Growth of the Use of Electrical Appliances.

The effect of the ever-increasing use of electrical appliances, due to the many causes for this increase in use, is being felt by Central Stations in many Municipalities of Canada to a very marked degree. A decade ago, when electricity was made use of for little except lighting purposes, the problems confronting Central Stations were exceedingly few; the demands were low; developments were small; the rates were high, and with the few customers that were being served it was an easy matter to make provision for the distribution of energy to supply the demand. With the introduction of electrical appliances, the individual demand for electricity has shown a rapid increase; developments on enormous scales have been con-

City	Population	Wired Homes	Number of Ranges	Percentage Saturation
Barrie	7,000	1,700	170	10%
Brantford	32,000	5,000	1,400	28%
Chatham	16,000	3,600	660	18%
Kitchener	22,000	4,400	660	15%
London	61,000	14,000	4,000	29%
Niagara Falls	16,000	3,200	900	28%
Stratford	18,000	3,600	1,500	41%
Windsor	43,000	11,000	4,000	36%

Table No. 2—Results of survey of Municipalities showing number of electric ranges in use.

structed and are being planned; rates have reached a point where to decrease them further would be the equivalent of presenting the service to the consumer gratis; the problems of supplying electric energy to consumers have assumed proportions undreamed of ten years ago.

The result of the demand for electrical energy to supply domestic needs alone is perhaps best reflected in the ever-increasing number of domestic users; the ever-increasing number of kilowatt hours required for domestic purposes, and the revenue produced; the increase in the average monthly consumption per consumer, and the reduction in the net cost per kilowatt hour for the current supplied. It is hard to realize that in the short space of ten years such a remarkable development as has taken place in Canada is possible. Electrical energy is being distributed not only to the homes of the wealthy, but to the most humble domain within reach of local distributing systems. Table No. 3 shows in a very striking way what has taken place in a few Municipalities whose records have been examined.

Typical Municipalities, of various sizes, where electrical energy is distributed by the Municipality show tremendous increases in consumption, revenue, number of consumers, and the average consumption with a remarkable decrease in the average cost per kilowatt hour for current delivered and consumed, and it is this average cost per kilowatt hour which is the determining factor in the increase in the rate of consumption, which is so remarkable in itself. The low cost of the consumption makes it possible to install appliances and other current consuming devices almost without limit, and brings electrical energy within the reach of all.

In this table are shown also the rates prevailing in these various Municipalities, indicating the decreases that have taken place from time to time, particularly because of the steady increase in rate of consumption, due to the extended use of electrical appliances, and when it is stated that the point of saturation,

Municipality	Population	Years	Domestic Consumption Kw-hr.	Domestic Revenue Dollars	Domestic Consumers	Av. My. Kw-hr.	Av. My. Bill	Net Cost Kw-hr.	Per 100 Sq. Ft.	1st 3 kw-hr. per C sq. ft.	Add. per kw-hr.
Toronto	530000	1913	4,220,000	$190,370.00	16500	25	$1.25	4.4c	4c	3c	
		1917	15,341,000	414,040.00	41400	34	.91	2.7	3	2	1c
		1920	33,568,000	729,365.00	57700	51	1.11	2.2	3	2	1
		1923	84,345,000	1,817,900.00	102040	74	1.36	2.1	3	2	1
Ottawa	113000	1914	1,376,000	$ 68,767.00	6400	19	$ .95	4.5	4	3.5	
		1917	2,376,000	81,506.00	8600	24	.82	3.4	3	2.2	1.1
		1920	5,960,000	109,800.00	9500	53	.97	1.8	3	2	1½
		1923	16,200,000	186,000.00	11100	126	1.44	1.15	3	2	1½
London	60000	1914	1,192,000	$ 57,500.00	5200	18	$ .83	4.8	4	3	
		1917	3,300,000	86,500.00	9000	31	.83	2.6	3	2	1
		1920	6,610,000	144,000.00	12400	44	.97	2.2	3	2	1
		1923	16,000,000	267,100.00	15000	92	1.53	1.8	3	2	1
Niagara Falls	16000	1917	868,000	$ 22,600.00	2300	31	$ .99	2.6	3	2	1
		1920	2,380,000	46,900.00	2900	68	1.34	2.0	3	2	1
		1923	6,200,000	82,400.00	3350	160	2.10	1.4	3	2	1
Mimico	4500	1914	91,200	$ 5,100.00	460	17	$ .90	5.4	4	4	
		1917	178,000	7,400.00	700	21	.93	4.2	3	3	1.5
		1920	508,000	12,300.00	850	50	1.22	2.4	3	2.5	1.25
		1923	1,470,000	23,000.00	1200	110	1.71	1.7	3	2.5	1.25
Baden	600	1914	7,000	$ 1,250.00	52	7	$ .75	10.	4	5	
		1917	10,000	842.00	60	12	.98	8.4	3	3.5	1.75
		1920	18,200	1,350.00	73	27	1.00	4.2	3	3.5	1.75
		1923	53,400	1,370.00	89	51	1.30	2.6	3	2.5	1.25

Table No. 3—Typical examples of growth of domestic use of electricity in Ontario.

on the average, is a long way off, it is hard to conjecture just what will be the limits of all the figures presented.

Proper Wiring of the Home.

Up to the time of the introduction of modern labor-saving devices into modern homes of Canada, very little attention was paid to proper wiring when the home was designed and constructed. Wiring generally was considered as a necessary evil, one which had to be taken into account, yet which was of no importance. The plumbing and heating equipments were generally the important considerations, outside of the actual construction of the building itself, and elaborate provisions were made for all the conveniences and comforts of these two items of building construction.

Nowadays, however, due to the increased popularity of electrical appliances, the education of the people to the economy and comfort of properly equipped homes, and the comparatively low cost of electric current, a very popular demand has sprung up for properly wired homes. Now the wiring problem, instead of being of minor importance, ranks in significance with that of the plumbing and heating.

To properly equip an electric home with electrical appliances many provisions must be made so that these appliances can be utilized to their fullest extent wherever and whenever necessary.

The first consideration is given to the capacity of the service bringing electricity into the home. Service wires of ample dimensions, to take care of present and future needs, are of vital importance, and homes being wired to-day make ample provision for extensions for years to come. With the service properly taken care of, the various rooms of the home can be examined to determine the need for proper wiring, to take care of the various appliances which may be used at all times.

In the living room provision is made to install outlets for ceiling and wall lights, and convenience outlets provided so that the electric cleaner, electric fan, table appliances, phonograph, electric piano, portable heater, electric fireplace, wired tea wagon, and the necessary number of floor lamps, can be conveniently accommodated.

In the dining room it is often desirable to wire up the table and the buffet; providing convenience outlets in these pieces of furniture for the use of the toaster, grill, chafing dish, and many other small appliances so useful in preparing a light meal or the afternoon tea. Wired furniture is coming greatly into vogue in modern homes, and many are the provisions made in the manufacture of this furniture for proper wiring accommodation. Outlets, of course, are provided for proper lighting of the dining room, as well as convenience outlets for the portable heater, vacuum cleaner, and other appliances.

In the bedroom, wired furniture again plays an important part in proper wiring facilities. The wired dresser, dressing table, and bed are

commonly used, so that the boudoir lamps, bed lamps, beauty appliances, and the warming pad may help to complete the equipment of "Milady's" chamber. Sufficient lighting outlets are provided to properly take care of the lighting of the dresser and the room generally.

In the clothes closets, and linen closets, outlets are provided for lighting their dark interiors, and in the hall you may find plenty of outlets for the use of the vacuum cleaner, portable heater, and ornamental lighting effects.

The kitchen is generally provided with convenience outlets over the table, over the stove, and other parts of the room, for proper lighting, and for the use of all kitchen appliances. Provision is made for the electric stove whether it is to be installed immediately, or some time in the future.

In the laundry provision is made for the use of the iron, washer, ironing machine, water heater, refrigerator, and other appliances, which may be found convenient and necessary to use.

The bathroom is wired to provide for the wall heater, immersion heater, and proper lighting of the room; and in the sun porch, where the sewing machine and decorative lamps are commonly used, outlets for these are of prime necessity.

In installing wiring for lighting throughout the home, control switches at the entrance to all rooms are found very convenient, and switches which will control the lights on one floor from another floor are generally installed to save steps running up and down stairs, when the lights are needed.

ELECTRICAL INSPECTION.

A proper house wiring installation is a primarily essential requirement in any community. Certain rules and practice must be followed to eliminate poor workmanship and the use of inferior material.

Adequate size of wire, proper insulation, solid mechanical attachments, precaution from contact with live circuits, elimination of fire hazards and many other vital points make a wiring installation proper. These considerations can not be left to the discretion of the wiring contractor, whose natural tendency may be to cheapen the installation by any means which might later be found to be a source of regret to the owner. These observations, as well as the ever increasing use of electrical appliances sold for use in the home, some of which require separate circuits of adequate capacity, specially protected, make necessary a general supervision of all electrical installations by some competent and impartial governing body, guided by a code of rules.

Then again it must be observed that many electrical appliances are dangerous when poorly built or of improper design. Constant use of a household appliance may soon result in an inferior one causing serious damage by fire, injury or loss of life. The innocent user of such appliances will soon learn with regret that an electric appliance would be a menace instead of a convenience if some precaution is not made to prohibit the use of improperly

built equipment of this nature. It must always be borne in mind that these household electrical devices are handled by the householder who is entirely unable to foresee the danger which may develop from use of improper appliances.

Approval of designs and precaution against faulty construction, make it essential that some authoritative body be established to be charged with the supervision of these devices.

The foregoing supervision of electrical work is accomplished in some provinces of the Dominion, by a body established by the Fire Underwriters' Association. A Fire Underwriters' code of rules furnishes a standard for electric wiring contractors. An inspection Department is maintained by this Association, to provide a means of inspection of all wiring installations and enforce the rules of the code. In the Province of Ontario, the inspection of electric wiring is in the hands of the Government and administered by the Hydro-Electric Power Commission, whereby wiremen are compelled to take out permits before the wiring can be commenced, and submit their work for inspection and final approval before the Central Station is allowed to energise the circuits.

Penalties are provided for failure to abide by the rules governing the taking out of permits, the wiring, or the energising uninspected installations.

The Code of Rules for wiring, is established by a joint committee, represented by the electrical manufacturers, jobbers, wiring contractors, insurance underwriters, central stations and the Provincial Fire Marshal, with a view to safeguarding the public against accident and property against fire damage through improper wiring installations. The general result of the adoption of these inspection methods, has been to induce a better class of workmanship and to make possible the almost unlimited use of electricity for domestic and other purposes.

The testing of new electrical devices produced by manufacturers, is conducted by the Hydro-Electric Power Commission. Each device is given an approval number, which is stamped on the article by the manufacturer after a sample of such has been tested and approved for use on electrical circuits within the province. By such a system, defective and improperly designed apparatus is excluded from general use and the public is protected from the danger resulting therefrom.

A Lighting Educational Campaign

International Campaign announced to promote the better lighting of homes in Canada and United States

By J. E. DAVIDSON

Vice-President, National Electric Light Association

The Society for Electrical Development is inaugurating an educational movement in Canada and the United States with the object of bringing before the people the advantages and needs of good lighting and has contributed the following for publication.—EDITOR.

THOSE who attended the National Electric Light Association Convention at Atlantic City in May, heard the first official announcement to the electrical industry of a great educational activity, so broad in its scope and so far-reaching in its ramifications that it may well be ranked in importance before any similar programme ever inaugurated by any industry.

The Better Home Lighting Activity is a nationwide undertaking. The financial support for its operation has been contributed by every branch of the electrical industry interested in lighting. While the executive control is, of necessity, vested in the relatively small but representative Lighting Education Committee, the tremendous amount of detail work so essential to its successful conclusion, offers to every electrical man in each local community an opportunity to contribute in no small measure to the effectiveness of this big, broad programme. To what extent, and with how much influence the local groups may contribute will be explained later.

THE PART THAT HOME LIGHTING PLAYED.

The part that home lighting played in the establishment of the electrical public utilities some forty-one years ago, has perhaps, been overlooked and forgotten in the rapid march of progress. The very excuse for the existence of the entire electrical industry at its inception was the providing of a new and better lighting service—an incandescent electric lamp which excelled the dim, flickering, open-flame sources of illumination then in common use.

To-day more than ten million homes in this country are wired for electric lighting, yet the industry as a whole has made little or no joint co-operative effort to educate the consuming public to the difference between raw light and illumination in the home, or to the bad effects of the improper use of light—gloomy, unpleasant rooms with their psychological influence on living conditions and what is most serious, the slow and constant ruin of the eyesight of young and old alike.

Education of the public has not kept pace with the scientific, engin-

eering and financial developments in the electrical field. It is true that some few manufacturers have been spreading the gospel of better light for ten or twelve years as a part of their own advertising and merchandising plans, and that, single-handed, they have been able to obtain very commendable and tangible results. The work that has been done shows the great need for the most powerful effort of the entire industry; it shows that the consuming public is ready for such educational work and willing to accept it; it forecasts the possibilities for both the public and the industry when the dormant, latent effort of every individual is moulded together into one big activity.

Obviously, the effort to better conditions should be a moral obligation of the electrical industry as a whole, as well as an individual responsibility. The education of the American family in home lighting is a service which the industry can well afford to render, since it will effect in the aggregate, a billion dollar market for lighting equipment and a quarter-of-a-billion-dollar annual market for electrical energy.

To Fulfill a Moral Obligation.

It was to assume the responsibility for fulfilling this moral obligation of the industry that the Lighting Educational Committee came into existence. Included in its personnel are representatives of the National Electric Light Association, the Society for Electrical Development, the National Council of Lighting Fixture Manufacturers, the Illuminating Glassware Guild, the National Association of Lighting Fixture Dealers, the Electrical Supply Jobbers Association, the Electragists and the Electrical Manufacturers.

The plan for the Better Home Lighting Activity calls for the coordinated operation of local activities in every community in the two countries. It is strictly educational in nature. The work as outlined contemplates reaching ten million families in wired homes. It is hoped to reach them through educational competitions designed to interest school children and operated both locally and nationally with the sanction and approval of school authorities. This work will be supplemented and reinforced by a direct advertising campaign in a large number of popular magazines.

The activity has already been assured of the sympathetic endorsement of such organizations as the National Education Association, the American Institute of Architects, and the Eyesight Conservation Council of America. Negotiations are under way which will lead to similar endorsement by other disinterested associations and individuals who appreciate the vast amount of good work which has been undertaken and are ready to lend it their support.

A Simple Explanation.

Perhaps the simplest explanation of the activity will be found in an outline of the plan adopted by one city for local operation. Bear in mind, if you will, that the flexibility of the national plan is such as to permit a great variety of local plans,

and that this particular plan has been used here only to illustrate and explain the details of the national plan.

In the community selected, it happens that the electrical industry functions through an Electrical League to a population of a million people. An executive committee has been appointed, the membership of which includes the chairman of the following sub-committees: finance, prizes, school relations, electrical home, publicity and advertising, and judges.

School Children Compete.

During September, October and November, this committee will operate among the school children a home lighting contest. Competition will be limited to children of high school age or less, regularly enrolled in the public, parochial and private schools of the community.

The first step will be the distribution through the schools of an attractive announcement folder which will display both the local prize awards and the national awards. With this folder will be given a registration card; to be signed by the child and returned to the committee. No difficulty is anticipated in securing the permission of the local school authorities to distribute this material. As a matter of fact, the entire plan has already been explained to the public school executives, and official approval is now pending. No school time, however, is to be spent on instruction in connection with the contest.

Every child who registers will be given a Home Lighting Primer. This will be supplied by the Lighting Educational Committee. It will contain the rules of the contest, a series of brief, simple lessons on home lighting, and the material necessary for the three competitive features.

To Win the Prize.

These will be:

1. To cut out of catalogue pages in the Primer the proper lighting fixtures for each room in the home and paste them in pictures of the several rooms provided for that purpose. A wide variety of specially designed, non-commercial fixtures will be provided, drawn to scale. The selection of shades and designation of wattages will be a part of this feature.

2. To fill in on brief forms provided for the purpose, a survey of the lighting equipment in the child's own home and in the homes of two neighbors.

3. To write an essay, not to exceed 600 words, on good home lighting, telling what it is, how to get it, and any interesting experiences in connection with home lighting.

The prizes to be offered by this local group will total fifty and will range downward in value from a year's tuition at college to prizes of lesser value. Half of the prizes will be offered to boys and half to girls.

The fifty local prize-winners will have their work submitted to the national judges in competition for the national prizes, which start with the offer to erect a $15,000 model home for the first prize down through several four-year college

scholarships to a number of prizes of lesser value.

The judges for the local competition have not yet been selected, but will finally be chosen from among the following: Educator, Clergyman, Prominent Attorney or Judge, Officer of the Chamber of Commerce, Editor of a daily newspaper and possibly other fields of distinction.

Arrangements will be made with a local newspaper to publish during the period of the contest a series of lessons dealing with good lighting in the home. This series of lessons will be prepared by the Lighting Educational Committee, and will be supplied to all local groups.

In the event that any school authorities or teachers request it, there will be available through the Lighting Educational Committee a teacher's handbook and other material of an educational nature such as short motion-picture film, brief lantern slide pictures, travelling displays and exhibit material.

Additional Publicity.

The advertising and publicity will include in addition to newspaper space, the use of the central station's bills for brief notices, window cards, poster boards and buttons or badges for the contestants. With the exception of the first two, arrangements for all of this material will be made through the Lighting Educational Committee. All of the local advertising will be made to tie in with the full page advertising of the Lighting Educational Committee in popular magazines.

As a further publicity feature, the real estate interests will erect several model electrical homes. These will be opened to the public during the period of the contest, and exhibited as duplicates of the first national prize. Particular emphasis will be put on the lighting of these homes, which will be constructed from the prize-winning plans submitted in a competition now being conducted by the Lighting Educational Committee in co-operation with the American Institute of Architects among five thousand architects. The home to be erected as first prize in the national competition will be built from this set of prize-winning plans.

Complete Plan Soon.

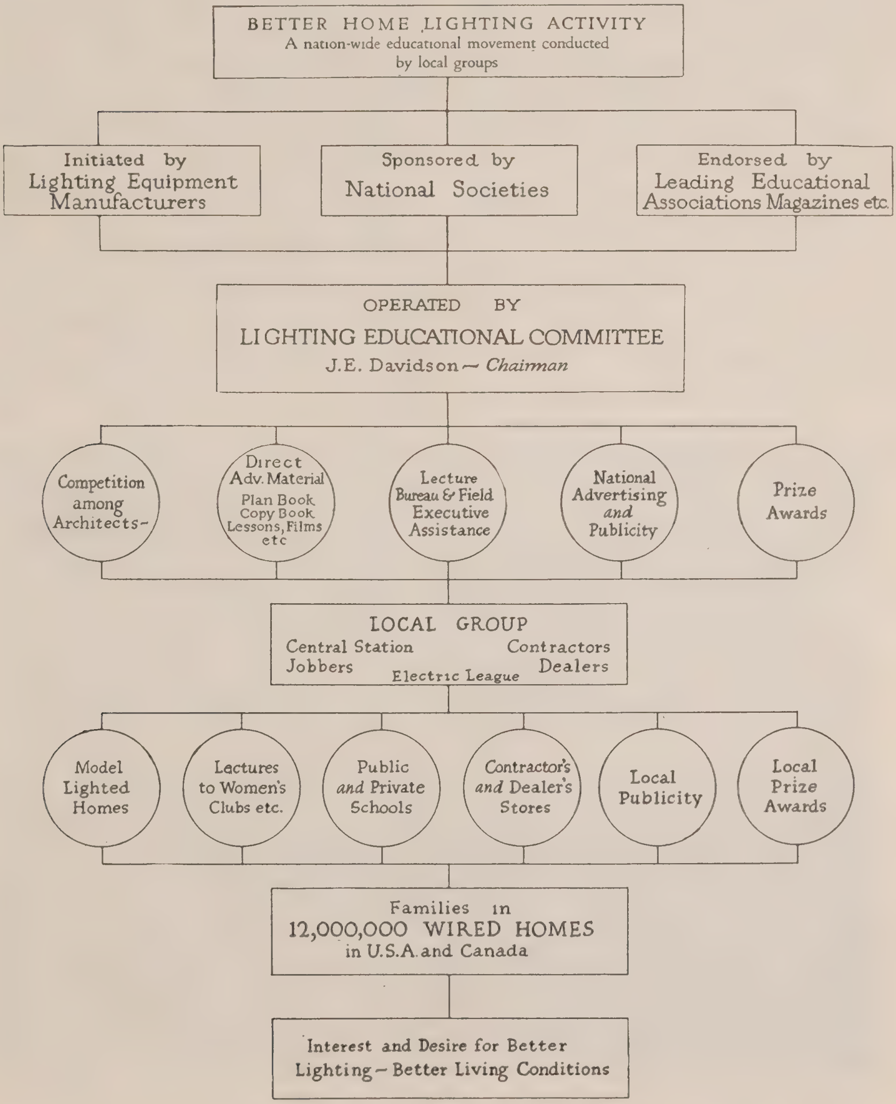
Shortly after this article is published, the Lighting Educational Committee will have available for distribution a complete plan book which will describe in detail the organization and its activities, and suggest several types of local organization and activities. It will also contain a complete catalogue of the services and material which the Lighting Educational Committee is prepared to furnish, and a catalogue of various ideas which may be adopted and worked into a plan for local use.

Service in the electrical industry cannot stop at the counter where a sale is made. We must go to the public and demonstrate how the homes of this country can get the most benefit from the scientific and engineering achievements of the past score of years. When we have shown our customers how to properly use electric light, how to pro-

tect their eyesight, how to lend beauty and charm as well as illumination to the home, we will have completed our job of illumination, and not before.

THE SUREST AND QUICKEST WAY.

The surest and quickest way to educate the American family is through its children. Once a child is entered in the Better Home Light-



Yours will be a most important part in this work. Won't you start now to plan how you will carry it out?

ing Activity, the intelligent interest of the entire family is assured. Competition in the activity will require a detailed study of the lighting equipment in every home, and will suggest ways and means of improving the obsolete equipment which may be found there to-day. It will do this both in words and in pictures—so simply that a child will readily grasp the message, yet so forcefully that the family will not forget it.

While the funds for the big national effort have been assured, it is hoped that the local groups will operate their activities with the assistance of local financing. The national organizations within the industry have all endorsed the activity and will support it one hundred per cent. The electrical manufacturers, the glassware manufacturers, and the fixture manufacturers have already given assurance of their hearty co-operation, not merely to the extent of their services, but with the more concrete proof of financial assistance.

What Success Should Yield.

While the purpose of this activity is sincerely and honestly to accept the obligation of the industry and complete the service it has to offer by rendering to the public a great educational service—still frankness compels recognition of the fact that if this service is successfully rendered, and if the homes of the nation are thereby brought up to a conservative, but healthful, standard of lighting, there would be a potential market for lighting equipment in excess of a billion dollars to be affected, and an annual central station revenue of a quarter of that sum.

And with it all, the public would be getting far more for its money in good vision, happiness, comfort and home attractiveness than it is to-day.

Windsor Municipal Station

By A. N. HUNTER

Electrical Engineering Department, H.E.P.C. of Ontario

THE growth of the Windsor power load has been extremely rapid since 26.4 kv. power was first supplied to this city from Niagara Falls by the H.E.P.C. in August, 1914. To give one an idea of the extent of this growth, the original transformer capacity of the station was 1500 kv-a. while, including the transformer now on order the transformer capacity is 18,500 kv-a.

The original station, a two storey building (50 feet by 20 feet) with basement was designed for a transformer capacity of 3000 kv-a., the first installation being two 750 kv-a. three phase transformers furnished by Canadian Crocker-Wheeler Co. These were shortly after augmented with two additional similar units from same manufacturer, and, later, three of them were replaced with 1500 kv-a units, two of which were furnished by the Moloney Electric Company and one by Canadian General Electric Co.

1922 Extension.

In 1921, it was apparent that a large extension would have to be

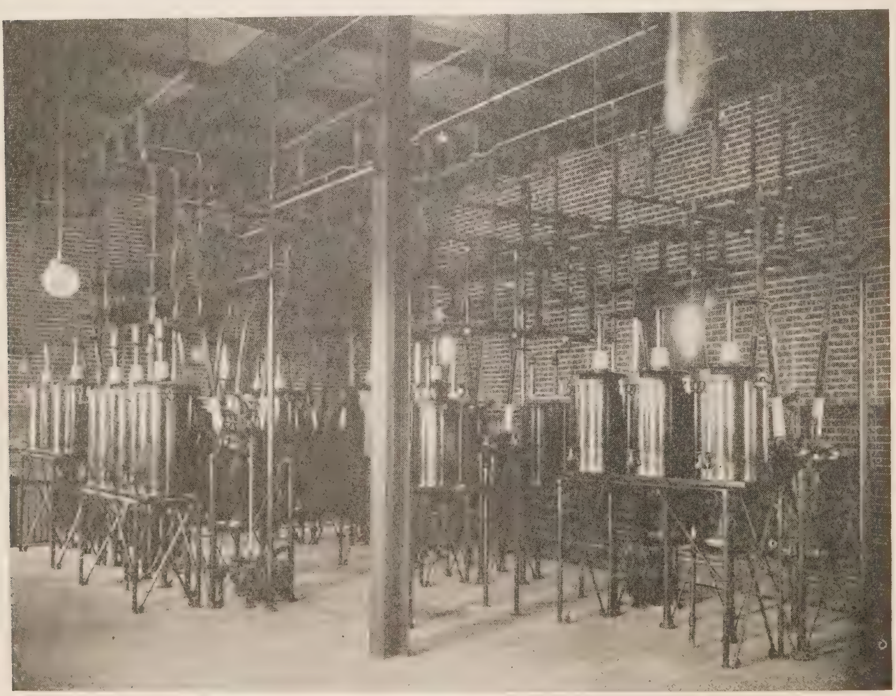
Extension to Windsor Municipal Station

added to this station to take care of the increasing load, and the Commission was authorized by the Windsor Hydro-Electric System to prepare estimates and plans for an extension to the station building with additional electrical equipment. Plans were prepared for a three-storey extension (84 feet by 33 feet) with basement and transformer capacity of 15000 kv-a. (five 3000 kv-a three phase units). Preliminary electrical layout drawings were also prepared for submission to the manufacturers for the supply and installation of the equipment.

Early in 1922, the contract for the building was awarded to Muxlow & Gale, contractors, of Windsor, Ontario, and contracts were awarded to the various manufacturers for the electrical and auxiliary apparatus.

The original electrical installation in 1914, consisted of 26.4 kv. and 4 kv. hand operated switching equipment, the 4 kv. oil breakers being of switchboard mounting type. The switching equipment for the 1922 extension is all electrically-operated and remote-controlled from the control room.

The extension is laid out with the 26.4 kv. switching equipment on the top floor, the control room with switchboard on the mezzanine floor, the power transformers and 4 kv. switching equipment on the ground floor, and the 4 kv. three phase



26.4 kv. Switch Room, Windsor Municipal Station

feeder regulators, the storage battery and motor-generator set, and the oil storage tanks in the basement. The appearance of the outside of the extension is in direct contrast to the original station, since the 4 kv. outgoing feeders are taken out underground in duct lines to various poles some distance away from the station so that the wall of the station is practically clear of obstructions as shown on the illustration showing the outside of the station.

The high tension room provides for four 26.4 kv. incoming or outgoing feeders, one of each being installed at present, and for switching equipment for five power transformers, three of which have been installed and the fourth is now on order. The 26.4 kv. bus has been extended from the original station into the extension. The control room contains the main switchboard with all meters, oil breaker controllers and indicating lamps, and relays and the service and battery-charging panels. All control conduits have been placed in the floors wherever possible so that the building is practically clear of same. All equipment including the lighting and heating services, is therefore controlled from this room.

The power transformer room was laid out for five 3000 kv-a. transformers with erection room with chain hoist, track runway, and transformer truck. After three 3000 kv-a. transformers had been installed it was decided that 5000 kv-a. transformers should be installed in the remaining pockets and one of these is now on order. The transformers are of oil insulated water-cooled type. An oil piping system with storage tank and electrical driven pump has been installed in the basement for handling the transformer oil. Water for the transformers is at present being obtained from the city water service, but the installation of a water-circulating system with cooling tower and pond and electrical driven pumps is now being considered for cooling the transformer water.

The low tension switching room was laid out for five power transformer feeders, sixteen outgoing feeders (eight commercial lighting and eight power), one bus-tie feeder, one service feeder, and one tie feeder to the 4 kv. bus in the original station. The 4 kv. main and emergency busses are installed with an oil breaker connected between same. The transformer feeders are connected to the centre part of the bus and are arranged so that they may be connected direct to the main or emergency busses. The lighting feeders are connected on one end of the bus and the power feeders connected on the other end with bus current transformers installed so that the 4 kv. commercial lighting and the power loads are measured separately on graphic meters. The outgoing feeders are connected to double throw double blade selector switches on the line side of the oil breakers so that these feeders may be transferred from the main to the emergency busses without interruption for overhauling the feeder oil breakers. This arrange-

Three 3000 kv-a. Transformers, Windsor Municipal Station

ment of feeders gives a very flexible operation of the station for overhauling the breakers or cleaning purposes. Each of the eight commercial lighting feeders is equipped with an automatic three phase feeder regulator erected in the basement. In 1922, switching equipment was purchased and installed for four lighting and four power outgoing feeders. The 4 kv. lighting load has increased far more rapidly than the power load, so that, when the present equipment on order is installed this year, there will be in service ten outgoing lighting feeders complete with regulators and four outgoing power feeders. Two of the additional lighting feeders are to be connected on "power" end of the 4 kv. bus and the regulators for same erected in the high tension room, special auxiliary current transformers being installed to include the load on these feeders on the "lighting" graphic meter and

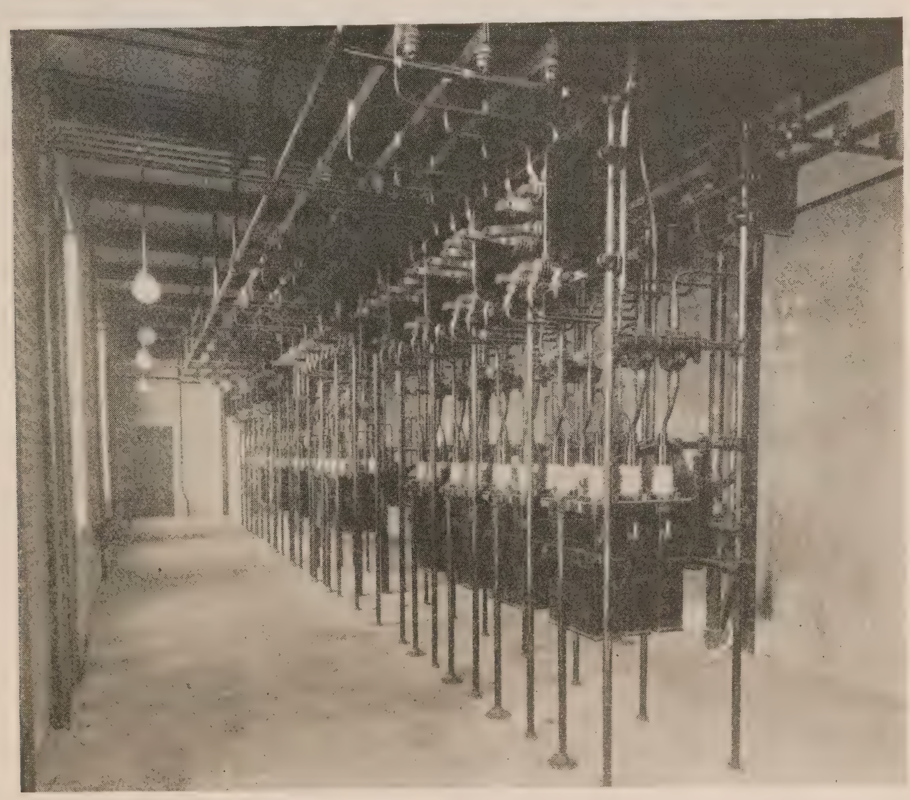
subtracting it from the "power" graphic meters.

RELAY PROTECTION.

The two 26.4 kv. incoming lines, being operated in parallel, are protected with reverse power relays to clear the line in trouble and inverse definite time overload relays to operate both lines. The three phase transformers are equipped with overload and differential relays, the overload relays controlling only the 26.4 kv. oil switch while the differential relays control both 26.4 kv. and 4 kv. oil breakers. The 4 kv. outgoing feeders are all equipped with inverse time limit relays.

ELECTRICAL EQUIPMENT.

The Canadian Westinghouse Company supplied and installed the 26.4 kv. and 4 kv. switching equipment for the 1922 extension, including all additions since that date, this equipment including 26.4 kv. type "GA-3" and 4kv. type "B-13" oil breakers, 100 kv-a. three phase feeder regulators and the switchboard with relays and controllers. The Canadian General Electric Company supplied the 26.4 kv. oxide film arresters, three 3000 kv-a. three phase 26.4. kv. transformers (including one in 1923), and the 5 kw. battery charging motor generator set.



4 kv. Switch Room, Windsor Municipal Station

A 60 cell type "E.7" battery for operating the oil breakers was purchased from the Exide Batteries of Canada, Limited. The three conductor 250,000 cir.mils paper insulated lead-covered cable with the outdoor potheads were obtained from the Standard Underground Cable Company of Hamilton, Ont. One additional 5000 kv-a. transformer is now on order with the English Electric Company of St. Catharines and will be installed during the present year.

Although the extension to this station was designed in 1922 to have ample capacity to handle the increase in the Windsor load for some years and was only placed in service in January, 1923, there will only be space available for one additional power transformer and two 4 kv. outgoing feeders when the electrical equipment now on order is installed in the fall of this year.

Wanted—A New Word

The money borrowed by progressive Canadian municipalities and by the Provinces for the installation of light and power and similar services is usually spoken of as "revenue-producing debt." We are assured from time to time that the "debt" of our municipalities is becoming a serious burden and a menace to their citizens.

The use of the word debt to describe much of this capital investment is altogether misleading. When the Hydro-Electric Commission and the City of Toronto took over the Toronto Power venture of the Mackenzie interests some thirty million dollars of private capital became at a stroke of the pen thirty million dollars of public debt. But there was no burden added to any taxpayer's load. The persons using light and power continued to pay interest on the public debt as they had paid interest formerly on the bonds of the power company. There was really benefit for them in the transformation of capital into debt, because the rates for energy were reduced materially when the Hydro stepped in.

A new word is needed to take the place of debt as applied to the borrowed capital invested in revenue-producing public services. In Britain there is a somewhat expressive phrase, "municipal trading," which is happier than "revenue-producing services," but in neither case is there explicit differentiation between self-sustaining investment and that which adds to the tax burden. Public service capital should be given a place of its own in all statements purporting to deal with the debts of the municipalities and Provinces of the Dominion.

—*The Globe.*

A Time Meter For Electrical Circuits

By PERRY A. BORDEN
Laboratories' Department, H.E.P.C. of Ontario

IN the life testing of incandescent lamps it is important that the total time each lamp is in circuit be accurately known. While this information can, of course, be obtained by taking careful records from a clock at the time of starting each run, there is necessary a considerable volume of computation, with the attendant possibility of mistakes; and this condition is greatly aggravated in case of an interruption to the circuit, particularly if this interruption should occur at night, or at any time when it is not convenient to obtain readings on a timepiece. With a view to simplifying this phase of the work there has been designed in the Laboratories a special time counter which reads continuously the time in hours and decimals thereof that the testing circuits are alive. Upon placing a batch of lamps on test it is necessary only to read the dials of the instrument, and this reading, subtracted from the indication at the end of the run, gives the actual time the lamps in question were carrying current.

This device is built up mostly of remnants of old types of watt-hour meters, and its external appearance with the cover on can hardly be distinguished from the early Aron two-rate meter with self-contained clock, which forms the foundation upon which the rest of the mechanism has been assembled. The clock in its original mounting, with its electrical winding gear unchanged, has been retained; and fitted to it is a contacting wheel geared to make five revolutions per hour. On diametrically opposite points of this master contactor bear brushes connected to alternately energize the two windings of a double-coil solenoid of the ironclad type. The plunger of the solenoid operates upward or downward according to which of the windings is connected to circuit, and its movement throws one way or the other a small drum controller, carrying four contact

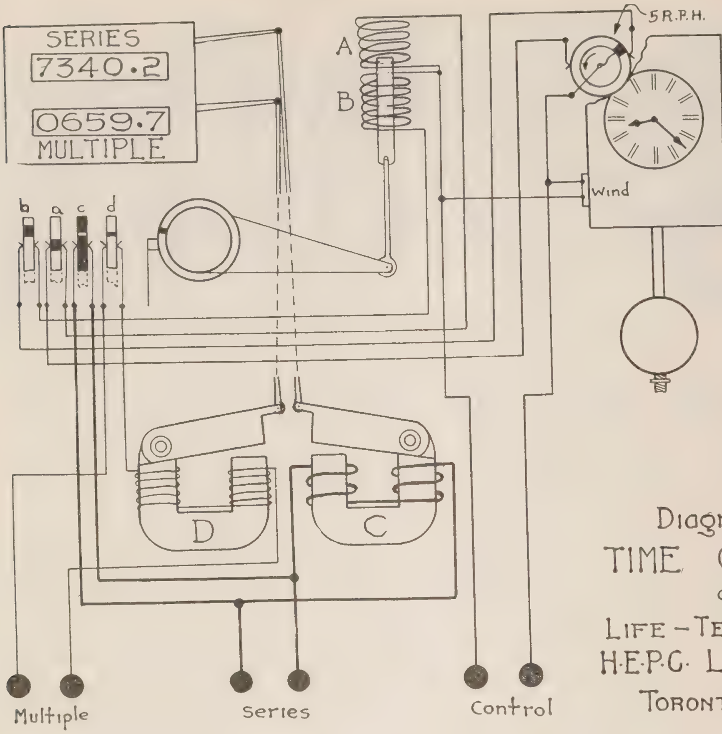
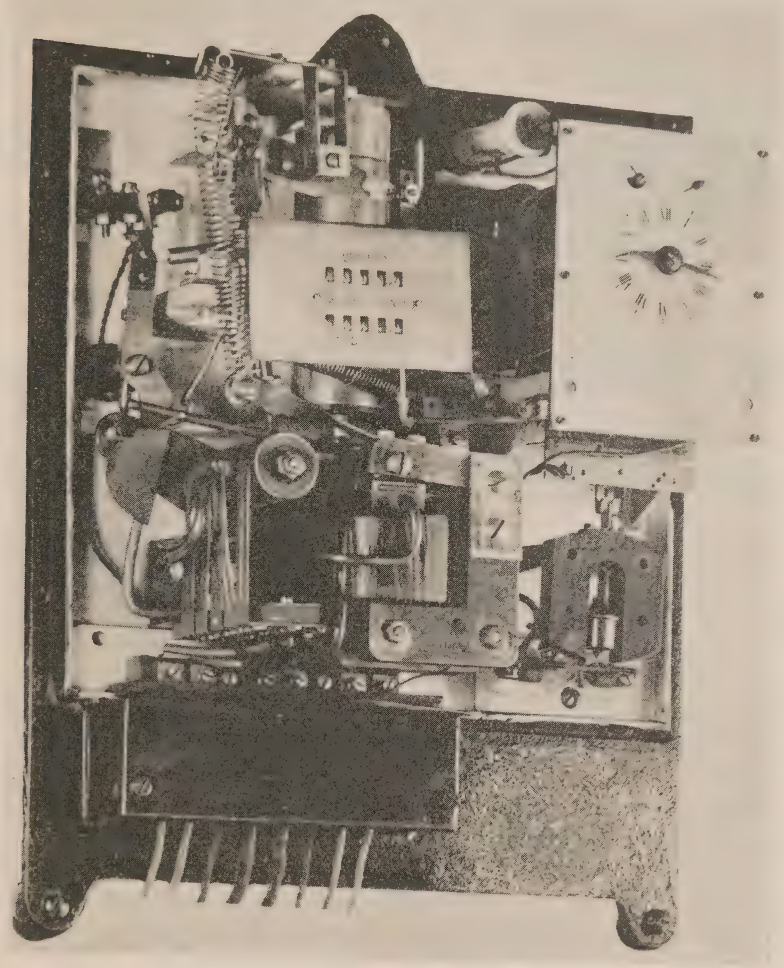


Diagram of
TIME COUNTER
on
LIFE-TEST RACKS
H.E.P.C. LABORATORIES
TORONTO ONT.

rings, whose functions are explained in the following paragraph. Two rather massive electromagnets operated respectively from the current of the series life-test rack and the voltage of the multiple rack, are linked to the gearing of a pair of counting trains which have been built from and occupy the same space in the assembly as the original resisters of the meter.

The actual performance of the instrument will be understood by reference to the diagram, wherein are shown the principal elements of the mechanism. The two windings on the main solenoid are shown at **A** and **B**, **A** being placed to pull the plunger up and **B** to force it down. The arrangement of the four contact rings of the drum controller is shown as a side view, it being assumed that the plunger has just received an impulse from coil **B** in the main solenoid, lowering that side of the drum and lifting the contact points of the rings to their highest position. It will be noted that while the circuit to coil **A** is now closed through the contact segment on ring **a**, that of **B** has been opened by the motion of the drum. This is an important feature of the device, in that the master contactor is relieved of the duty of breaking the circuit of the main solenoid, the arc being taken by the comparatively heavy and rapidly moving parts on the drum. When the contact on the clock completes the circuit of **A** the plunger will rise, breaking the circuit at **a** and



Time Counter with Cover Removed

closing it at **b** ready for the next operation. By this arrangement the controller is rotated through a small angle in alternate directions, and is thrown over ten times in each hour.

The coil on electromagnet **C** is arranged to carry the main current of the series life-rack, but is normally short-circuited by the copper ring **c**, whether the plunger be up or down. Upon throwing over, however, an insulating segment in the ring momentarily opens the short circuit, energizing the magnet, and advancing the corresponding counting train one division. In a similar way the coil **D**, wound for the voltage of the multiple rack, and normally open-circuited, is momentarily energized through the copper segment in ring **d**, counting one on the multiple dial as the con-

troller throws over.

Thus there is obtained a continual counting on the dials, as the time is checked off by the master contactor on the clock. If the supply to either test rack is cut off, the corresponding dial will, of course, cease advancing, until the power is returned to the circuit; while if the whole power supply is interrupted the recorder remains inert, the clock continuing to operate from energy stored in an auxiliary spring, until service is restored to the system, when it immediately rewinds and assumes its normal function.

Fire Protection For Electric Generators

Tests at Queenston Station Using Carbon Dioxide

By C. B. STEPHENS

Electrical Engineering Department, H.E.P.C. of Ontario

EXPERIMENTS were recently conducted on one of the 45,000 kv-a. vertical generators to determine if Carbon Dioxide gas could be successfully applied for extinguishing electrical fires in such machines. Within the last three years a number of tests and at least one installation has been made on steam turbo-generators by our neighbours to the south.

Steam or water systems have been installed in various plants for combating generator fires, but considerable doubt exists as to its real efficacy partly due to the ever-present danger of leaks causing an insulation breakdown.

The air-cooling system on the turbo-generator is quite often totally enclosed, that is the air flow is through the generator, then through the air cooler or washer, thence back through the machine. In this case CO_2 can be easily mixed with the cooling air by merely blowing the necessary quantity into the air stream.

Experiments have proven that 10 per cent. of CO_2 in air will not support combustion, although for practical purposes a higher percentage is advisable as a safety factor.

The air flow on the vertical generators is positive; the air enters the machine through ducts below the rotor and discharges through the stator into the outgoing duct, the normal rate of air flow being 125,000 cubic feet per minute. It is obviously impractical to add sufficient CO_2 to this air stream to smother fire.

The test results are shown graphically in Fig. 1 with explanatory notes. In tests I. and II. the discharge duct only was closed. The relatively high static pressure in the generator chamber resulted in excessive air leakage and rapid dissipation of CO_2. Test III. was made with both discharge and inlet ducts closed and serious leaks around the air

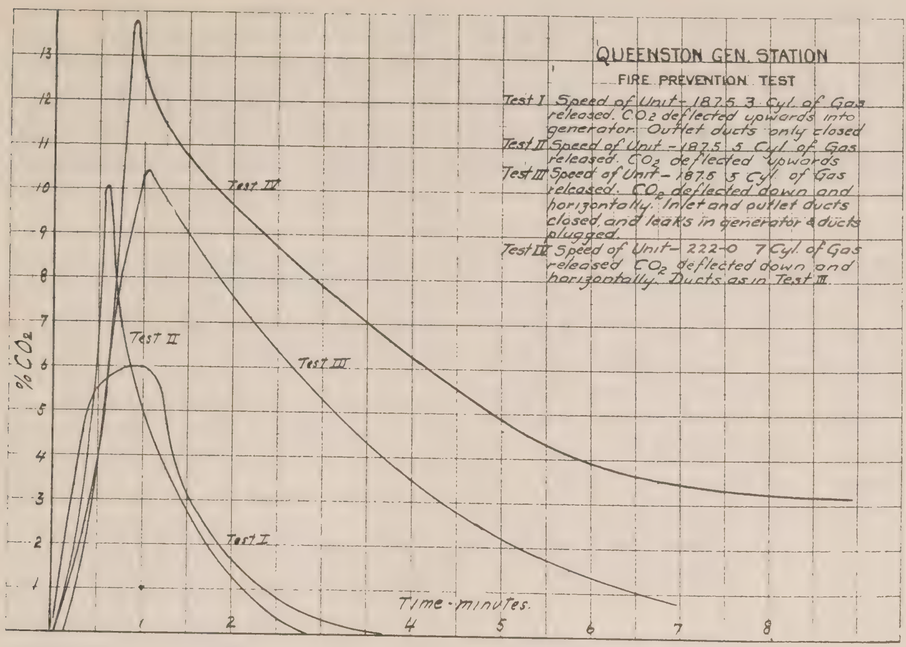


Fig. 1

chamber were plugged. The greatly reduced leakage in test III. compared with that in test II. resulted in a much better retention of CO_2 as evidenced by the greater area of the curve for test III. than that for test II., the same quantity of gas being used in each case. The generator ran at normal speed during these trials. Test IV. represented an emergency stop in that the initial generator speed was 222 rev. per min. and the final speed zero in 7 minutes and 14 seconds. This initial high speed increased the static pressure in the generator chamber and the leakage therefrom is indicated by the steep peak of the concentration curve. The concentration then drops gradually as the speed decreased and remains practically constant after the machine comes to rest. The four test curves of Fig. 1 show on inspections that the maximum concentration of CO_2 is 2 per cent. per cylinder of CO_2 used.

In arranging a generator fire protection scheme employing CO_2 it is therefore imperative to prevent all possible leakage at the generator settings and air dampers. The amount of gas used must be sufficient to produce an initial concentration of 10 per cent. or more as soon as possible after trouble develops and to maintain it for a reasonable length of time.

Gas samples during the tests were drawn from the top end connections of the generator through tubing by a small motor-driven rotary pump and collected in toy balloons. These samples were analyzed in a standard Orstat apparatus. Each cylinder

contained fifty pounds of liquid carbon dioxide (450 cubic feet of free gas).

Some novel features regarding the conduct of the tests are possibly of interest to Readers of the Bulletin. For instance, the expected concentration of CO_2 in the generator chamber would be dangerous to life due to the deficiency of oxygen in the air. On investigation, a small motor-driven rotary pump such as used for isolated domestic water systems was found to be an excellent air pump both for suction and pressure. This pump effectively drew to a safe location a continuous supply of gas from the generator chamber for inflating the toy balloons.

A known mixture of air and CO_2 was pumped into a balloon to see if the CO_2 would leak out. After two and a half hours the sample was analyzed and the concentration of CO_2 had decreased about 25 per cent. It was apparent therefore that gas samples collected in rubber balloons should be analyzed promptly to avoid errors.

Twenty steel cylinders commonly used for storing compressed gas were equipped with special siphon tubes and valves in order to release the gas rapidly in liquid form. Cylinders so equipped will completely discharge in forty seconds, but those without siphon tubes require several hours, as the rapid evaporation of the liquified gas soon freezes the remainder in the cylinder, which then evaporates as the thawing proceeds. Gas pressure in fully charged cylinders in about 1300 pounds per square inch at ordinary temperatures.

As the gas in the cylinders had to be released by hand, those doing that work retired into one of the air inlets where fresh air was obtainable until the completion of each test. A violent hissing sound accompanied the emission of gas while dense white clouds of carbon dioxide snow drifted upward into the generator.

The J. T. Donald and Company, Limited, Montreal, furnished valuable data during the preliminary investigations and Engineers of Messrs. Walter Kidde and Company, Inc., New York City, rendered material assistance and advice during the tests. The rotary pump was loaned for the occasion by the Albany Pump Company, Limited, Toronto.

Hydro News Items

Central Ontario System

Contracts have been signed with eleven residents in Seymour Township for electric service and an extension of 3.5 miles will be built to provide service.

* * *

Negotiations are proceeding for the establishment of a Rural Power District in Douro Township in the vicinity of Lakefield.

* * *

A by-law was passed by the Township of Thurlow for the signing of a contract for electric service, with the Hydro-Electric Power Commission. Individual contracts are being signed to provide for service to users in the vicinity of Point Ann.

* * *

Niagara System

Barton Township is arranging for the sale of additional Hydro debentures for an amount of $50,000 to take care of extensions to the Township Hydro-Electric System. That part of Barton Township adjacent to the City of Hamilton is growing very rapidly, approximately 800 customers being served.

The Commission is increasing the capacity of the sub-station at Wallaceburg, one of the large power consumers having increased its load to approximately 1000 horsepower.

* * *

Additional transformer capacity is being installed by the Commission in its sub-stations at Kingsville and Blenheim.

* * *

The Sarnia System is arranging to construct a second 26,000 volt sub-station in the southern part of the city close to the Imperial Oil Company, which is one of its largest consumers.

* * *

The Port Colborne System has obtained approval for the erection of an office building. The construction of the new Welland Canal through that municipality has disorganized the business district, a large number of the business blocks having to be removed. This change also necessitates the removal of the 30,000 volt sub-station of the Commission.

* * *

Arrangements are being made to transfer some 400 or 500 consumers located outside of the limits of the City of London from the lines of the London Public Utilities Commission to those of the London Rural Power

District, which is operated by the Commission in the adjoining townships.

* * *

St. Lawrence System

In reply to a request from a new industry installing a silk manufacturing plant at Cornwall, known as Courtaulds Limited, the Commission has quoted prices on various blocks of power.

* * *

A general meeting of representatives from many eastern municipalities in Eastern Ontario was held at Prescott recently, at which Sir Adam Beck addressed the delegates on St. Lawrence development. The Eastern Municipal Power Association, formed several years ago, was revived and new officers were appointed. There was a unanimous agreement that the St. Lawrence power development should be undertaken without delay, to provide adequate power for the eastern part of the province.

* * *

Rideau System

Small hamlets are adopting street lighting systems. Spencerville has just completed a system of 13 lights, while the Village of Maitland is starting to install one.

* * *

The Village of Kemptville, after a series of legal actions, is now in undisputed possession of its streets and has the sole right to distribute light and power to the inhabitants.

List of Electrical Material, Devices and Fittings

Approved by The Hydro-Electric Power Commission of Ontario in May 1924.

Appliances

THE ELECTRIC HEATERETTE COMPANY, 119 King St., London, Ont.

Electric Bed Warmer.

* * *

THE McCLARY MANUFACTURING Co., London, Ont.

Circulation Water Heaters, Cat. Nos. 110, 210, 220, 320 and 72, respectively.

* * *

NATIONAL ELECTRIC APPLIANCE CO. (Mfr.), 727 East 125th St., Cleveland, Ohio.

R. B. CLARKE (Agent), 28 Dundas St. W., Toronto.

Electric Curling Iron "Duchess" and "Gold Beauty".

* * *

CANADIAN WESTINGHOUSE COMPANY, LIMITED, Hamilton, Ont.

Circulation Water Heaters, Style Nos. H. 19206, H. 19207 and H. 19208, respectively.

Flat Irons, S#H. 20052.

Portable Motors, Type C.A.H.

* * *

RITTER DENTAL MANUFACTURING

COMPANY, INC., Rochester, N.Y.

Portable Dental X-Ray Equipment.

* * *

J. H. CONNOR AND SON, LTD., Ottawa, Ont.

Electric Washing Machine, Model No. 4.

* * *

CANADIAN GENERAL ELECTRIC COMPANY, LIMITED, Hotpoint Works Division, Stratford, Ont.

"Hotpoint" Radiant Grill, Cat. No. G. 10.

* * *

ELECTRIC VACUUM CLEANER CO., INC., Ivanhoe Rd., Cleveland, Ohio.

"Premier Duplex" Vacuum Cleaners, Model Nos. 53 and 62.

* * *

THE SHARPLES SEPARATOR CO. (Submittor), 2368 Dundas St. W., Toronto.

THE SHARPLES SEPARATOR COMPANY (Mfr.), West Chester, Pa.

Motor-Driven Milking Machines.

* * *

THE MAYTAG COMPANY, LIMITED (Submittor), 181 Market Ave., Winnipeg, Man.

THE MAYTAG CO. (Mfr.), Newton, Iowa.

Electric Washing Machine "Maytag".

* * *

STAR ELECTRIC COMPANY, LTD., 185 Lombard St., Winnipeg, Man.

Immersion Type Water Heater.

* * *

THE NIAGARA ELECTRIC COMPANY, 325 Beech Avenue, Toronto, Ont.

Portable Air Heaters, Type I-9.

* * *

NATIONAL ELECTRIC HEATING CO., LIMITED, 544 Queen St. E., Toronto, Ont.

Round Table Stove, Cat. No. 190.

* * *

BEATTY BROS., LIMITED, Fergus, Ont.

Electric Washing Machine, "White Cap".

* * *

CANADIAN HOME APPLIANCE MFG. CO., 150 Fullerton St., London, Ont.

Electric Washing Machine, "Ideal".

* * *

*BASTIAN-BLESSING CO., THE, 240-258 E. Ontario St., Chicago, Ill.

Electric Carbonators, "Knoxall" and "Eclipse" Models.

* * *

*ELECTRIC WELDING MACHINE CO., Detroit, Mich.

Electric Welding Machines.

* * *

*BECKWITH MFG. CO. (Mfr.), 111 Summer St., Boston 9, Mass.

BECKWITH BOX TOE, LIMITED (Submittor), Sherbrooke, Que.

Electro-Vapor Box Toe Heaters, Styles 10A, 12, 12A and 12B.

* * *

*WARD MFG. CO., INC. (Mfr.), 3047 Sheffield Ave., Chicago, Ill.

A. KENNETH COULTER (Submittor), 9 Wellington St. E., Toronto.

"Ward" Curling Iron, Type 2BA, 2WA.

* * *

*KELLEY-KOETT MFG. CO., THE, INC. (Mfr.), Covington, Ky.

A. C. BURKE (Submittor), 312-14 Hobberlin Bldg., 9 Richmond St. E., Toronto.

X-Ray Apparatus.

* * *

*Haber Die & Stamping Co., Electrical Division, 864 North Ave., Chicago, Ill.

Portable Air Heater, Cat. Nos. 20-12, 20-14.

* * *

*Regina Corporation, The, Rahway, N.J.

Suction Cleaner, Types "23" and "24".

* * *

Switches

Dominion Electric Manufacturing Company, Limited, 60 Sumach St., Toronto.

Enclosed Switches, Cat. Nos. 96211, 97311, 56251-58 incl., 56351-58 incl., 56451-58 incl., 97351-53 incl., 57354-58 incl., 51242-48 incl., 51342-48 incl., 51442-48 incl., 56341-46 incl., 56441-46 incl., 56261-68 incl., 56361-68 incl., 56461-68 incl., 51262-68 incl., 51362-68 incl., 51462-68 incl.

* * *

National Equipment Company, Limited, 1 Wabash Ave., Toronto, Ont.

Automatic Switches — Pressure-operated Type.

* * *

Cutler-Hammer Manufacturing Co., Milwaukee, Wis.

Interlock of the Electro-Mechanical Type for Elevators.

* * *

Northwestern Electric Company, 408-416 South Hoyne Ave., Chicago, Ill.

Auto Transformer Starter and Controller.

* * *

Fixtures

Menzies & Company, Limited (Submittor), 439 King St. W., Toronto.

The Greist Manufacturing Company (Mfr.), New Haven, Conn.

"Wallace" Portable Lamp.

* * *

Fittings

W. H. Banfield & Sons, Limited, 370 Pape Ave., Toronto, Ont.

"Banfield" Fuseless Attachment Plugs, Cat. No. 650.

* * *

The Canton Porcelain Co., Olive Place, N.E., Canton, Ohio.

"C.I.Co". Porcelain Tubes.

* * *

K. T. Foundry, Limited, Galt, Ont.

Outlet Plate "KT".

Conduit Fitting—Boxes, Types A, B, C, E, F, G, H, J, K, T, X, LB, LR, LL, PM, PT, PMX, PMT, FS, FSC.

* * *

*French Mfg. Co., The, Grandview Ave. and Robbins St., Waterbury, Conn.

Wire Connectors.

* * *

*America-Wiremold Co., Mfr., Hartford, Conn.

Conduit Co., Ltd. (Submittor), 126 Don Esplanade, Toronto, Ont.

Metal Raceway Fittings (As listed on Underwriters' Laboratories card, dated March 14, 1924).

Metal Raceway for Surface Wiring, Cat. Nos. 500, 700.

* * *

Miscellaneous

*Electric Service Supplies Co., Limited (Mfr.), 17th and Cambria Sts., Philadelphia, Pa.

Lyman Tube & Supply Co., Lim-

ITED (Submittor), 10 Ste. Sophie Lane, Montreal, Que.

Lightning Arrester.

* * *

*GENERAL ELECTRIC Co., York Works (Mfr.), York, Pa.

CANADIAN GENERAL ELECTRIC COMPANY, LIMITED (Submittor), Toronto.

Fixture Wires—Asbestos-covered. "Salamander", "Colored Salamander", "Deltabeston" and "Colorbeston".

Asbestos-covered Wires. "Salamander", "Deltabeston".

* * *

*These devices are under the Underwriters' Laboratories re-examination or label service.

Light In The Hen House

And now, other issues having grown threadbare, demagogues are beginning to hurl maledictions against the public utilities on the score that the electric lighting industry is spreading propaganda to induce farmers to light their hen coops at night and early mornings so as to induce the chickens to lay more eggs. They, the utilities, are assailed as soulless and heartless, preying on the patient, defenceless hen, and endeavoring to thwart the laws of nature which decree for the lowly egg-layer a period of partial rest during the winter months, and all to the sordid end that the greedy corporations may increase their sales of service and gather more filthy shekels.

Passionate eloquence is being marshalled in concentrated fury against a nefarious practice which would slip one over on the gullible barnyard fowl. This time, however, the utilities are not required to fight their own battles. A staunch champion has arisen, girded with the power of the press.

A story going the rounds of Iowa newspapers says artificial lighting of hen houses is not for the purpose of fooling the hens but it is really a boon to them. It is for the purpose of giving them a chance to eat more. As eating is one of the few enjoyments in the life of the hen, it is really adding to the sum total of her happiness. Says the story:

"The artificial lighting of hen houses has become permanent and popular during the last few years. Contrary to the first opinions of some people, electric lights are not installed for the purpose of fooling the hens. The use of light merely endeavors to aid in duplicating spring conditions whereby hens have more opportunity to consume a large amount of feed and thus have material with which to manufacture a large number of eggs. Lights in the evening will give the hens less time between the last evening meal and the first one in the morning, so that the crop never gets empty".

This explanation and defense comes entirely unsolicited and the electric industry absolutely denies that it inspired the story.

—*The Synchronizer*

THE
BULLETIN

Published by
HYDRO-ELECTRIC POWER COMMISSION
of Ontario

190 University Avenue
Toronto

Subscription Price $2.00
Per Year

Changes In Electrical Inspection Rules

OUR readers will be interested in learning that the Commission has just issued the Seventh (revised) edition of Rules and Regulations governing Electrical Installations for Buildings, Structures and Premises.

This book measures 4 inches by 6 inches instead of 7½ inches by 5 inches, and will be found more convenient for the pocket; furthermore, since the size and spacing of type is the same as that used in former editions it will be just as easily read as before.

Several changes have been made in the general arrangement and location of rules, and special effort has been made to eliminate repetition, under several different headings, of rules which were identical or of very similar import.

Some rules in the previous edition were found to be unnecessary and have been left out or properly taken care of under the heading "General Rules".

The following entirely new subsections have been added: "Isolated Light and Power Equipment for Potentials below 50 volts", "Electrically-operated Organs" and "Outdoor Work on Private Property or Premises".

The old rules under "Wireless Telegraph Work" have been replaced by a new and much more extensive set entitled "Radio Installations".

It may not be generally known that in order to ensure as far as possible that observance of the rules shall not result in hardship, or even inconvenience, to anyone, the Commission some years ago gave all interested bodies an opportunity of voicing their opinions by establishing a Rules and Regulations' Committee, composed partly of members of the Commission's own staff, and partly of members of other organizations who have been selected by these organizations to act as their representatives on this Committee. The Committee at present comprises 10 members of the Commission's staff and representatives of each of the following organizations:—

American Institute of Electrical

CONTENTS

Vol. XI. No. 7

JULY, 1924

Convention Number

Engineers, (Ontario Branch).

Ontario Association of Electrical Contractors and Dealers.

Ontario Association of Electrical Contractors and Dealers (Toronto District).

Canadian Fire Underwriters' Association.

Canadian Electric Supply Jobbers' Association.

Electrical Supply Manufacturers' Association.

Fire Marshal of Ontario.

Ontario Safety League.

Association of Municipal Electrical Utilities of Ontario.

Ontario Association of Architects.

Revision of the Rules was entrusted to a small sub-committee of four men, two of whom undertook the actual work in close co-operation with the other two.

In addition to obtaining comment from members of the Committee, the Sub-Committee also circulated draft copies of the Rules to all the inspectors in the Electrical Inspection Department, and, in this way, secured much valuable light on many points from men who are in a specially good position to know the difficulties which come up in actual application of the Rules and Regulations.

The Rules relating to "Radio Installations", referred to above, were drafted by a special Sub-Committee of six, two of whom were men particularly well acquainted with radio work.

The Rules in general accord with those of the 1923 edition of the National Electrical Code which was very carefully gone over in order that important changes therein might be given full consideration, and every effort has been made, by suitable wording and punctuation, to make each requirement perfectly clear.

A small pamphlet, uniform in size with the Rules, is being published by the Commission; in this will appear the more important of those rules which are entirely new or which, being old rules, have been changed in some respect so as to embody new requirements. Those familiar with former editions will readily recognize these additions and changes.

The price of this new book of Rules is 25 cents per copy.

OPENING ADDRESS

by J. E. B. Phelps, Sarnia, President

I WISH to welcome the delegates to this Convention, as President of your Association; and I want to inform you that this is one of the largest conventions that we have had. The registrations show that we have had over 300 apply for reservations at the hotel; and there will be, no doubt, a large number of delegates coming on who have not yet arrived.

Major Lewis, in his remarks this afternoon, spoke about the canals and canal system of our country, leaving out the power question, as he said you men would probably be more acquainted with the power question than he was. In that he touched upon a very vital point. As members of this Association, do we really realize the important part that we play in the industrial life of our Province? Let that thought come home to us, and let us try to get a vision of what has been the fundamental reason for the great success of the Hydro undertaking. I think you will agree, when we analyze it, that it all comes down to the word "Service." All of us in our various municipalities are doing the best we can to serve the people of our municipalities to the best of our ability, to give them the service that they are demanding; and it is this service which is being rendered through the various municipalities that has been one of the great reasons for the success of the Hydro undertakings. Our great opportunity as electrical men, and our great duty, is to shoulder this great responsibility for service. This responsibility not only includes the Hydro executives and employees but also extends to the manufacturers and jobbers; and these men we are glad to have with us as members of our Association. It is up to the manufacturers and jobbers of electrical machinery and appliances to see that the people can obtain machinery and appliances that are dependable; because, unless we can get into the homes of the people proper appliances we cannot give them the service which we desire to render. Let us be loyal, then, to the Hydro and this Association, because through our Association we can improve our methods of rendering service. Let us remember the old motto that He profits most who serves best.

This meeting is the result of co-operation. The Committees are entitled to the heartiest praise for their efforts.

Since coming to the Convention I have heard that some men have had a complaint about the reservation they have got at the hotel. When we reached here two years ago, we had a real difficulty in getting rooms, and some men who had telegraphed two weeks ahead did not get a room at all. This year we are much more agreeably situated and we can thank the Committee which has had charge of that part of the programme.

Another interesting thing is the invitation which this Association received from the O.M.E.A. to affiliate. There have been a good many things put out about it, but I am sure that most of

you do not understand the basis on which it is proposed to be brought about, if at all.

At the last Convention this was brought up, and it was left to the Executive to report upon at this Convention. They have a report ready, which will be read at the proper time; and in this report you will find that the Executive Committee are recommending affiliation. The basis of affiliation is set out in a letter, some 300 copies of which have been printed and will be distributed to the delegates, so that you will all be aware of the basis of affiliation. In that regard, let us keep in mind, while discussing it, that the O.M.E.A. is the parent organization. Let us not forget that the men who compose that Association are the elected representatives of the people. They are men who are in that Association because they were elected by the people in the municipalities to that position, and they employ us. We work for the Commissioners who form the O.M.E.A. Let us keep that in mind while we are discussing this affiliation and come to a conclusion that will be, as I hope, for the benefit of both Associations.

* * *

TAXES

Speaking for the Kiwanis Club of Sedalia, Mo., Jesse W. Barrett, Attorney General of Missouri, said that when taxing authorities "soaked" the public utilities with heavy taxes, they were merely "soaking" the public which used the utilities; that higher taxes inevitably meant higher rates for service rendered by the utility companies, and that the general public in the end paid all taxes through the rates they pay for service.

Mr. Barrett said, in part: "The dog chasing his tail, the ostrich hiding its head in the sand, are no more foolish than we are about taxes. We put extra tax burdens upon public utilities and think our own pockets saved that much of the expense of government.

"Then we must fix utility rates high enough to yield them a fixed percentage over and above those taxes and we pay the rates we fix, which always must include the taxes we impose upon the utilities. We lose, in addition, the extra cost of handling the circle of payments and collections. In the case of the railroads the farmer loses still more. High freight rates are to him almost a double burden, for they are added to everything he buys and subtracted from everything he sells. He pays taxes by way of paying freight charges, but, too often, he pays twice his share. High taxes are one of the main causes for the prevailing high freight rates, and lower railroad rates are absolutely a pre-requisite to better farm conditions.

"All taxes, by the inevitable process of economic distribution, are paid by the public, and when the public tucks its head in the sand, its tail feathers are all the easier to pluck."

—*Automatic Telephone*

Analysis of Operating Costs in Hydro Municipal Systems

By G. F. DREWRY, Assistant Engineer, H. E. P. C. of Ont.

EVERY industrial organization should analyze its cost of operation, production or whatever may be the cause of such expenses it is required to meet.

Up-to-date manufacturing concerns often go to great expense to establish a cost system or to renovate an unsatisfactory one, probably inadequate through growth or lack of modern application. Many concerns fail through the inadequate provision of this essential instrument. By the information revealed from its application, many improvements and economies are effected in administering, managing, producing and selling, etc. Many losses are stopped by such a system. Success may often come when failure might otherwise be inevitable.

It has been interesting to note, in recent engineering publications, some suitable costing systems for electrical contractor-dealers who apparently have not been generally adopting adequate systems in the past. A costing system is a vital requirement for all contractors for estimating and tendering on contracts.

The Hydro Utilities are not comparable to industrial organizations in every respect. No tender or contract has to be submitted in the usual sense. Efficiency in management, production, distribution, or selling, etc. may be required in a publicly owned utility, not in order that it may meet competition for example or continue to thrive where it may have a monopoly of the business. A costing system is not essential for these purposes, whereas it is of vital use to industrial concerns. Such a system applied to utilities publicly owned may be useful however. With it, one can compare the operation of one municipality with another and help to diagnose the ailments of an inefficiently managed utility. Probably there may be excessive losses resulting from poor management, lack of management, improper engineering, too much overhead expense, too costly construction, etc. A proper system to make such an analysis is valuable in itself, but a more important purpose is served by a suitable system of analyzing the annual opertion of a utility. Briefly, it is the purpose of supplying a basis of making rates for public service. In Hydro Utilities it is the one effective instrument to adjust rates for securing a service at cost. It is the basis of justification for reduction of rates to one class of service and increase to another.

The operating analysis serves many secondary purposes. It will disclose the diversity of demand in each municipality, which in itself, explains different rates in otherwise similarly comparable utilities. It will show the cost of power to each class of service

as distinct and separate from the cost of distributing it locally. From it one can make comparison of distributing costs. It will show the degree of efficiency in management of the utility. Overhead expense is indicated as a separate cost of operation. Distribution of capital is determined from such analysis and much other information.

It was not long after municipalities began operation under the Power Commission Act, before it became evident that a uniformity of rates must be adopted to secure effectively the enforcement of a policy of service at cost, to eliminate discrimination in charges for service or bonusing of corporations, etc.—all of which would soon lead to the disintegration of the great Hydro System, now established in the Province on a substantial and secure basis able to withstand attacks from the many causes which are frequently experienced. With the rates adjusted from time to time, on the basis of so sound a principle as power at cost and with the determination to use this as the chief guide in all circumstances, we are able to keep the great Hydro undertaking free from disintegrating influences, safe, alive and thriving. As above stated, the Operating Analysis is the main instrument for guidance in these rate adjustments.

It will be of interest to many to have repeated herein, portions of the Power Commission Act relating to the subject under discussion in this article.

Part III. Section 39 is as follows:—

Whenever it appears from the accounts of a municipal corporation or municipal commission that after providing for any payments required to be made on account of principal or interest of any debentures issued for the construction and equipment of works and plant for the production, development or distribution of electrical power or energy, and, in the case of a municipal corporation or municipal commission receiving electrical power or energy from the Commission for distribution, after providing for the payments required by this Act, that there is a surplus at the credit of the municipal corporation or municipal commission, such surplus shall be applied and disposed of, in such manner as the Commission may by general regulation or special order direct,

(a) in the reduction of any indebtedness incurred with respect to the construction and equipment of such works and plant; or

(aa) in purchasing or otherwise acquiring a site and erecting thereon buildings for the occupation and use of the municipal commission as offices and for other business purposes, subject to the approval by the Commission of the site and cost and of the plans of any such building.

(i) Subject to such approval, any such office building may be larger than is required for the immediate use of the municipal commission and any part of such building not immediately required for the use of the municipal commission may be leased by it to the corporation or to any other muni-

cipal commission for the purposes of any public utility in the municipality;

(b) in the maintenance, repair or renewal thereof; or

(c) in the extension of such works and plant; or

(d) in the formation of a fund to be used at a future time for any of such purposes;

(e) to the extent to which such surplus is derived from the supply of electrical power or energy for the public buildings of the corporation or the lighting of the streets of the municipality or for the operation of any street railway or electric railway or any public utility owned and operated by the corporation,—by payment over of such surplus or of such portion thereof as the said Commission may deem proper to the treasurer of the municipality to be applied to the general purposes of the corporation.

(2) It is declared that subsection 1 shall apply to every municipal corporation or municipal commission which has entered into a contract with the Commission for the supply of electrical power or energy, notwithstanding any provision to the contrary or any inconsistent provision in any general or special Act heretofore passed.

Section (e) quoted, especially requires that some basis of apportioning costs must be used to enable the Commission to properly fulfill the duties set out therein. Without the information shown in an annual operating analysis, it would not be possible to know the amount of surplus to return to the treasurer of the municipality.

The following is a detail resume of the method of making a typical "Analysis of Annual Operation of a Hydro Utility". It is first understood that there are a number of headings, departments or classes under which the subdivisions of expenses and revenue are made. These are as follows:—

Lighting—Includes domestic and commercial customers.

Commercial Power—Includes all industrial customers receiving power at power rates.

Municipal Power—Includes all municipal waterworks' power supply, power service for municipal sewage works, power service for schools and any public service supply sold at power rates; the revenue for which is paid out of municipal treasury funds. Street railway is excepted from this department.

Street Railway—Includes service to municipally owned and operated street railways taking Hydro power.

Street Lighting Regular — Includes municipally owned street lighting service in general use, on the streets of the municipality; cost of which is met by general tax levy.

Street Lighting Ornamental—Includes municipally owned street lighting service of special use in a defined section of the municipality; the cost of which is sometimes met by special tax levy, usually on a local improvement plan.

Rural Power—Includes service to customers on rural lines outside the municipal limits, now discarded, due to the present policy of establishing rural power districts.

Miscellaneous — Includes operations other than the above, such as merchandising and general activities.

POWER COSTS.

The first item of operating expense to consider, is cost of power supplied to the municipality. This part of the annual operating expense is probably the most important in smaller municipalities at least, and it is a satisfaction to know that it can be much more definitely and accurately distributed in small municipalities, where this cost is proportionately greater than other items of operating expense.

The maximum demand for each class of service to be used for dividing power costs, is determined by reading the daily load charts of the municipality. The average of the twelve monthly peaks obtained for each class, is the basis of prorating the cost of power.

In determining the maximum demand of each class, a detail knowledge of the various operating conditions is obtained. All power demands of individual customers are required as well as their classification. Demand of waterworks' power or other municipal power loads must be known. Complete information is required of the street lighting equipment, number of lamps, rating of lamps and power demand shown by the charts. This is checked by using connected load. The all-day lighting demand or demand of lighting appliances must be calculated as accurately as possible. Power loads occurring simultaneously with lighting peaks, must be accounted for. Overlaps occurring at morning, noon and early evening usually have to be ignored because of the impossibility of analyzing conditions occurring at such times.

Losses resulting from transformers may be of sufficient importance to need special investigation, in order to more accurately apportion the demands among the various subdivisions. This is especially true where the power factor of the municipal load is low, on account of large transformer capacity attached to the lines. It is necessary in such, to determine the reactive kv-a. belonging to each class. Power loads may have poor power factor and be the main cause of increased power costs, in which case, power factor should be taken into account in determining the demands of this class.

The maximum demand for lighting shall be determined from the lighting peak, after due correction for class "A" power used at this period of the day and deduction for street lighting demands, waterworks' power demands, railway demands and losses in transformer installations for which lighting is not accountable.

The demands for commercial power as determined from the charts, must be the net demands after deduction for lighting during daytime and domestic appliance loads. Losses not attributable to power should be deducted. If power factor correction affects the cost of power supplied to the municipality, that part of cost arising from power load is charged against the power department. A careful analysis of the reactive kv-a. charts will reveal suf-

HYDRO-ELECTRIC DEPARTMENT

OF THE MUNICIPALITY OF ONTARIO

FOR YEAR 1922

ANALYSIS OF POWER LOADS	Total Maximum Demand From Records of Charts a (kw.)	CLASS	Maximum Demand of Class x (h.p.)	% Reduction	Maximum Demand Reduced to Common Basis y (h.p.)	$\frac{y \times a}{x}$ kw	%	Wire Feet	%	Consumers
Lighting	248	A				248.0	44.6	335,000	64.3	1106
		A	11		11					
		B	114.4	10	103					
		C	261.3	10	235.2					
Power		D	142	33-1/3	94.7					
		E								
		Short Term								
		Off Peak								
Sub-Total	222.6		528.7		443.9	187.0	33.7	60,000	11.5	18
		A								
Water Works		B	142	10	128	85.6				
		D								
Sub-Total	95						15.7			
Railway		Special								
Street Lighting, Regular	23.3	A				23.3	4.2	125,000	24.0	
Street Lighting, Ornamental	10.0	A				10.0	1.8	1,000	.2	
Rural Power		Special								
Total						556.9		521,000		
Per Cent.										

Sheet No. 1

ficient data to determine corrections to the demands of the commercial power department.

Due to the sale of power under classes restricting the time of use, a reduction of the demand determined from the charts must be made to place it on a basis of unrestricted use, as other classes enjoy. The aggregate power sold under each classification is accordingly reduced in accordance with the following percentages:—

Class	"A"—Nil	per cent. reduction
"	"B"—10	" " "
"	"C"—10	" " "
"	"D"—33-1/3	" " "
"	"E"—25	" " "

The reduction of the power demands sold under these classes, puts the demand of each class on a basis of unrestricted use. What we require, however, is the reduced net diversified demand of the power department, to an unrestricted basis and as the chart readings give us the diversified demand without reduction, it therefore remains necessary to reduce these readings in proportion of the aggregate of the class demands, on the basis of unrestricted use to class demand aggregate on restricted basis.

To elucidate on this matter, I would refer you to the typical operating analysis. Sheet 1 shows demands of each department. Column 1 gives the average of twelve monthly demands recorded on the load charts. In the power department, which we are considering, this is indicated as 222.6 kw. This is the demand of a number of customers, some of which are restricted to certain hours during the day and it is consequently not on an equal basis with other departmental demands where unrestricted use prevails. To put it on a comparable basis with such

departments, a reduction is made in proportion of the aggregate demands of power classes reduced to a common basis (443.9 h.p.) to aggregate demands of power classes, not reduced (528.7 h.p.). After this reduction of the chart readings the demand becomes 187 kw. or 33.7 per cent. of the total of all departments.

Waterworks demands are treated in a similar manner, except that all power controlled to keep off the municipal peak and used for municipal purposes under this department is considered as Class "D".

Railway demands are usually determined from chart records or indicating demand meters and at times composite peaks have to be determined from measurements made at several points of delivery.

Street lighting demands are determined from the power charts. This is usually definitely indicated and can be checked by the knowledge of the connected load. If there is an ornamental system of street lighting, as well as a regular system, the demand of it may be determined similarly.

Substation Operation and Maintenance:

The maintenance of substations is charged directly to each particular department, where possible.

Any general expense incurred in maintaining substation buildings, equipment, etc., which cannot be assessed against any particular department is subdivided among all on a maximum demand basis.

The substation operating costs are divided among the various departments on the basis of the power demands of each unless there is some portion of it properly chargeable to a portion of equipment requiring special attention. Moving machinery installed for any particular department, may need more than average operating attention and a proper proportion of operating expense is charged against this.

Distribution System Maintenance:

This expense is divided between departments on the basis of wire mileage of the distribution system used for each. The wire mileage is derived from detail maps or records of the distribution system circuits and the procedure used is as follows:

Primary or secondary circuits used exclusively for one department, such as street light circuits or commercial power circuits, are chargeable to the proper department.

Primary circuits used jointly by several departments are divided according to the use made by each. Usually the capacity of transformers connected or maximum demands on such circuits are made the basis of dividing the mileage.

In 4000 volt star systems the fourth ground wire on the top of the pole is considered as primary. Where a neutral is used as primary ground wire and secondary lighting, it is divided one half to each. When used as a ground wire for primary line and secondary lighting and a return wire for street lighting, it is divided one third to each of these.

Line Transformer Maintenance:

Expenses incurred under this head are chargeable to the class of service for which the transformers are used. If transformers are used for a dual

HYDRO-ELECTRIC DEPARTMENT

OF THE MUNICIPALITY OF ONTARIO

FOR YEAR 1922

ASSETS	Lighting	Power	Water Works	Street Railway	Street Lighting Regular	Street Lighting Ornamental	Rural Power	Total
					PROPORTIONS CHARGEABLE TO			
44.6-33.7-15.7-4.2-1.8 Lands	5779 04	4366 67	2034 52		544 22	233 25		12957 48
Buildings								
Transmission System								
Sub-Station Equipment	3437 20	2931 22	1640 08		1071 43 514 70	200 65		9795 28
Distribution System, Overhead								
Copper and Services	20258 20	3599 75			3630 00	42 39		
Poles and Hardware	8281 04	1707 39			3547 15			
								41065 90
Distribution System, Underground								
Line Transformers	5545 81	5912 39				140 00		11598 20
Meters and Devices	10856 40	650 00						11506 40
Street Light Equip., Regular					2324 76			2324 76
Street Light Equip., Ornamental						1920 00		1920 00
Sub-total	54157 69	19167 42	3674 40		11632 24	2536 27		91168 02
Miscellaneous Equipment								4016 70
Old Plant								14622 15
Total								109806 87
Per Cent.	59.4	21.0			12.8	2.8		

Sheet No. 2

purpose, such as street lighting and commercial lighting, the expense in such case is proportioned between the two departments in accordance with the use each makes of the apparatus.

METER MAINTENANCE:

Meter maintenance is charged directly to those departments which cause such expense.

STREET LIGHTING OPERATION AND MAINTENANCE:

If there is an ornamental system of street lighting as well as a regular system, expenses should be separated, or kept in separate accounts, and charged directly to their respective departments; otherwise the division of expense is determined from the account.

BILLING AND COLLECTING:

Expense due to this work is divided on the basis of the number of accounts or bills for service sent out. On account of the greater work and complication in making out power customers' bills and collecting, each of these is counted as five ordinary bills.

FIXED CHARGES:

As these consist of interest on capital indebtedness and sinking fund or debenture payments, a proper allocation of the capital indebtedness among the various departments must be made in order to determine the proportion of these expenses each should carry. For this purpose a separate series of calculations and tabulations are made. Sheet No. 2 shows the computations essential to distribute capital indebtedness in accordance with the plan devised for dividing same. The detailed method of dealing with this, is as follows:

DIVISION OF CAPITAL INDEBTEDNESS:

Lands and buildings shall be propor-

tioned on the basis of the use made thereof. Station sites, buildings, etc. are divided in proportion to the station equipment. Office buildings and merchandising establishments are chargeable to the respective departments utilizing them, and in proportion to such use as is made of them. Capital in any property not utilized is left undivided.

Station equipment capital is allocated to the different apparatus installed and reproportioned between departments, on the basis of use made thereof. Any capital cost which covers a part of the equipment installed especially for any particular department, is charged directly to such department. For example, street lighting will be charged with all capital in street light regulators and switching. Equipment used generally and not particularly for any special service is charged against the various departments on a basis of the demand of each department.

Transmission systems and distributing mains where found in use, are analysed to determine the use made of each and the capital of such is divided on this basis. This involves determining the loads transmitted.

Distribution systems consists of poles, hardware, lines and services and the capital of this account must be apportioned under these headings. Before a proper subdivision into departments can be made certain rules are followed. The capital in poles and hardware is determined by deducting the cost of copper in the lines and the cost of services. The latter is sometimes kept in a separate capital account but if this is not the case an estimate must be made. This is usually done by allowing an estimated cost per service for additions made from year to year. The cost of copper is deduced by a knowledge of the size of copper and mileage as determined from maps showing lines, or engineering records of the distribution system. After deducting the capital in copper and services from the total capital in the distribution system, the remaining portion representing poles and hardware is subdivided among departments on the basis of wire mileage carried for each. The cost of copper is chargeable directly to the departments making use of the circuits of the distribution system. Capital in services is charged directly to light and power as determined.

Underground distribution system costs are divided upon demand basis or connected load basis, among the departments using these circuits jointly.

Line transformers are charged directly into the departments which make use of them. Transformers that supply two or more departments, such as lighting and multiple street lighting, are divided among these departments in accordance with the demands of each, or use made of such.

Meters and devices are separated into light and power departments by investigation of this account and by correction from year to year of additions to capital for each department.

Capital in regular street lighting equipment is chargeable directly into that account. This is also the case with capital of ornamental street lighting.

Miscellaneous equipment, as the title indicates, consists of various parts of the plant not primarily classified or es-

HYDRO-ELECTRIC DEPARTMENT

OF THE MUNICIPALITY OF ONTARIO

FOR YEAR 1922

OPERATION AND MAINTENANCE	Lighting	Power	Water Works	Street Railway	Street Lighting Regular	Street Lighting Ornamental	Rural Power	Miscellaneous	Total
				PROPORTIONS CHARGEABLE TO					
44.6-33.7-15.7-4.2-1.8									
Power Purchased	11595 40	8761 55	4081 78		1091 94	467 98			25998 65
Sub-Station Operation	1465 20	1107 11	515 78		137 98	59 15			3285 20
Sub-Station Maintenance									
64.3-11.5- -24.0-.2									
Distribution System, Maintenance	644 57	115 28			240 59	2 00			1002 44
Line Transformers Maintenance	210 70								210 70
Meters and Devices Maintenance	34 74								34 74
Consumers' Premises Expenses									
Street Light Maintenance, Regular					160 00	90 43			250 43
Street Light Mainten., Ornamental									
Billing and Collecting	653 00	54 90							707 90
59.4-21-4-12.8-2.8									
Fixed Charges, Local	2941 28	1039 85	198 07		633 81	138 65			4951 66
Fixed Charges, Rural									
Rural Expense									
Sub-total	17544 89	11078 69	4795 63		2254 52	758 19			36441 72
48.1-30.4-13.2-6.2-2.1									
General Salaries and Expenses	687 06	434 23	188 55		88 56	30 00			1428 40
Promotion of Business									
Undistributed Expense	255 09	161 23	70 00		32 88	11 14			530 34
Total Operation Maintenance	18487 04	11674 15	5054 18		2385 76	799 33			38400 46
REVENUE	20708 32	10553 63	4602 50		3637 50	1000 00		830 37	41332 32
Gross Surplus	2221 28				1251 74	200 67		830 37	
Gross Deficit		1120 52	451 68						
Depreciation	1561 63	552 09	105 16		336 51	73 61			2629 00
Depreciation, Rural									
Nett Surplus	659 65				915 23	127 06		830 37	302 86
Nett Deficit		1672 61	556 84						

Sheet No. 3

sential for continuous use. If any appreciable portion of the capital in this account can be properly subdivided or apportioned to various departments, this should be done. Some of the capital may be properly left undivided.

Old plant capital is undivided, since it is not used by any department.

From the foregoing distribution of capital, a basis is prepared for the subdivision of interest and debenture payments and this same method is used to apportion the depreciation expense which is to be found farther down in the list of annual expenses.

OVERHEAD EXPENSES:

The remaining operating expenses, i.e., general salaries and expenses for promotion of business and undistributed expenses are overhead costs and are subdivided on a general percentage basis of all other operating expenses, not including depreciation.

With a knowledge of the revenues from each department and a determination of the expenses as outlined in the foregoing pages, a direct deduction can be made as to the amount of surplus or deficit in each.

The merchandising department has not been reviewed in particular, in this article thus far. In order to make the

operating analysis balance with the operating statement, it is the usual practice to carry a heading on Sheet No. 3 for this department, wherein the profit made in merchandising is set out as "revenue from miscellaneous sources". As it is the net profit of operation from merchandising after all proportional expenses have been charged, it is accordingly indicated as "nett surplus" on Sheet No. 3.

The results of these computations outlined herein, are recorded for each municipality by the Commission from year to year and accordingly provide a record to guide it in the fulfillment of its duties as laid down by the Act under which it operates. This work is carried out in a conscientious manner with the main object of having results indicate what action should be taken at all times. Following this procedure prevents criticism which would otherwise be difficult to eliminate. It is in short an instrument by which is secured one of the fundamental principles of Hydro Service—viz.: *Service at cost.*

Discussion

MR. DREWRY: I have had some typewritten questions about the operating analysis, handed to me by Mr. Powell, of the Toronto Hydro. I had to explain to Mr. Powell that he was the representative from the largest city in the Province of Ontario, and that this is rather a crude instrument to make an analysis for the City of Toronto. To put it in another way, this might be a fine basis, but it would have to be considerably enlarged for the City of Toronto.

As to his first question:—

"1. You show Domestic Lighting and Commercial Lighting combined. What basis would you use to separate them?"

We do not use a basis for separating the domestic from commercial lighting. As the paper shows, there is only one department called the lighting department, which includes both domestic and commercial lighting. The division of domestic from commercial lighting has been thought of from time to time, but it has been found difficult to make a division in these two departments. They are so much alike. Their loads coincide, and the plant which we use for these two departments is used in a combined way, making it difficult to make a very accurate subdivision of costs between the domestic and commercial lighting.

Our statistics, as shown in the Annual Report of the Commission, indicate that the cost of the two are much alike. Generally the cost per kw-hr. for commercial is a little lower, which you will agree with me is as it should be, because there is more concentration of business in the commercial than there is in the domestic, and as such it should be more economically served. On the other hand, there is not so

much diversity of demand in the commercial as there is in the domestic. I believe, from Mr. Powell, that they have some basis for dividing the two.

"2. (a) Has the Hydro-Electric Power Commission made studies of Diversity factor of the various classes of service?"

Yes, the Commission has investigated the diversity factor and made a study of it from these very records, for their own purposes. We have had on many occasions to make investigation of diversities and loads in various departments, and in one department with another.

"(b) What are reasonable diversity factors from the services to the terminal station for Domestic, Commercial lighting, and Power (unrestricted)?"

As I have pointed out, there is no division between domestic and commercial. The diversity factors for power vary considerably, depending upon how many customers there are in a municipality and how big the demand, and whether the demand is mostly concentrated in one customer. You have no regular condition of affairs that you can apply to all municipalities.

"3. What are reasonable demand factors which may be used in estimating the class demand from connected load; for Domestic lighting, Commercial lighting, Power (unrestricted)?"

Answering that, I would say that we have between a quarter of a horsepower and a quarter of a kw. as the average demand of a lighting customer. That holds pretty well throughout the Province.

In power, the diversity is generally 1.25. But it may vary considerably from that. There may be no diversity at all, as where the load is concentrated on one power user; while where you have a large number of power customers, the diversity will be much higher.

"4. How does the wire space basis for dividing overhead pole capital expenditure compare with wire mileage basis?"

We use the wire mileage basis for the distribution of maintenance cost as well as the capital of the whole system. We have never used the wire space basis. I believe the wire space basis is the basis the Toronto system uses for their own local analysis.

"5. What basis should be used in dividing underground duct capital expenditure?"

That problem applies only to larger places which would have the underground systems installed, the total capital in the duct as well as in the cables is generally divided on the demand basis of the various departments which use that duct system as well as the cables.

MR. V. S. McINTYRE, Kitchener: I am quite in accord with Mr. Powell, of the Toronto Commission, that commercial and domestic lighting, if possible, should be separated. There are two distinct rates made for this service; and on account of making two rates, the cost of each service should be determined if possible. In Kitchener, the commercial rate is higher than the domestic rate. Our commercial load is always segregated in one section, and the distribution of cost in the commercial service is low, as compared with the domestic service. If the Hy-

dro Commission could devise some scheme for separating the two kinds of load, I think we could arrive at a more equitable basis for our rates.

They have provided for municipal power by way of sewage, waterworks, street railway and so on; but they leave out power supplied to municipal buildings, that is the City Hall, and so on. We have a new City Hall going up at Kitchener, which will take a hundred horse-power. If at the end of the year we can turn back a little surplus, we are all right.

In arriving at the cost of underground ducts, there was another question. We have a considerable mileage of underground system, and in installing these ducts we have made provision for fire alarms. The fire department of the City uses these ducts but they do not pay us any rental for them. The question is what should the cost of those ducts be charged to?

MR. DREWRY: I do not think it is impossible to get a system to segregate the costs of domestic lighting from the costs of commercial lighting. Probably some day a system will be devised of segregating these two departments. There would be quite difficult problems to solve in this connection in some municipalities; in others it might be quite easy.

If Mr. McIntyre has a definite basis of supplying his commercial customers, and a definite equipment separate from domestic lighting, I think it would be easy to make a classification of commercial and domestic lighting, making two departments and segregating the costs. One of the hardest things would be to get the true demand of each; but under certain conditions that might be very readily done. Generally, the two rates are run hand in hand, and there is some relation between them. There is or should be a definite relation between the rates in all the municipalities; if there is not, there must be some specific reason which could be explained.

All municipal power should be included. Sometimes there are so many detailed services of small consequence rendered to the municipal buildings, and so on, that there is no account taken of them. If a hundred horse power is going to be taken at the City Hall, I would consider that would have to be taken into account.

The cost of the duct system used by the fire alarm service should be charged to the fire department, worked out on a cost basis and credited to the revenue which is received from all services of the duct system. There is no justification for your giving the duct system free to the city. If you are anxious to be equitable to the town in giving back an adjustment on the hundred horse power at the City Hall, you should be equally exact in getting a rental from them for the duct system.

MR. E. I. SIFTON, Hamilton: I would like if the author could explain to me why there is no diversity factor allowance on street lighting, while they do give a diversity factor allowance on waterworks pumping, which may be 24-hour power, 365 days in the year.

MR. DREWRY: Waterworks get no benefit for diversity with other departments, unless they can so re-

gulate the demand as to affect the peak of the municipality. Since street lighting cannot do that, it cannot ask for a diversity factor allowance. The basis of dividing the power costs in a municipality, as well as some of the other costs, is that of getting all loads to an unrestricted basis, and then they are all on an equal basis. If your waterworks are restricted to keep off the peak, they are then properly subject to some consideration on that account. The street lighting is not controllable and therefore it cannot be considered as entitled to benefit from it.

If you consider that your municipality should give the street lighting consideration because the municipality is experiencing a need, then you immediately get into difficulty when changes come in the municipality, in these times when the peak occurrence may be only of passing consideration. We have municipalities which change their peak from daytime to night in the period of their growth, and from night to daytime. There is only one basis of dividing the costs and that is the unrestricted use of the power in the final adjustment.

MR. SIFTON: I do not think my question is entirely answered. Hamilton has about five months when the peak is in the daytime and does not interfere with street lighting at all. We do not pay anything for power used for street lighting during those five months. The waterworks is heavy on the peak in that time. There is a diversity in the waterworks, but it is absolutely at the time when we do not need it. Very little help can be got from the waterworks at the time of our peak. It looks to me as if waterworks should not have the diversity but should be taken in on a 24-hour arrangement.

MR. DREWRY: If they cannot keep off the peak of the municipality with the waterworks load, certainly the waterworks should not receive any benefit from diversity.

MR. SIFTON: They are both peak loads, and it seems strange to me that the system does not take cognizance of it.

MR. DREWRY: Unless restriction gets you something by reduction of your costs, there is no reason for a restriction of your service. It would look to me as if there would be no benefit obtained by your keeping the waterworks off at certain times, as the demand is in the daytime. You could not get consideration by having that load off the peak, as it would not be a restricted load.

MR. SIFTON: I am not speaking about any restriction of 33 1/3 or 10 percent. off, but general diversity factor, where your total demands total up to, say, 150 percent. of your actual demand. Now street lighting does not get anything there at all, while the waterworks does.

MR. DREWRY: Would you give lighting any cut there?

MR. SIFTON: I think it should come in under the general diversity factor. Our all day power load in the summer time is away from the street lighting load. Our power gets 33 1/3 off, on account of diversity, the waterworks gets probably 30 percent. off while street lighting does not participate.

MR. DREWRY: The final basis of the division of power costs is an unrestricted use of the class that you are dealing with. Street lighting is an unrestricted use.

Possibly some misunderstand the basis of reducing the power department's demands to an unrestricted basis, and in order to explain that to you, I would refer you to sheet No. 1, and you will observe there that 11 h.p. represents the demand of a class A customer in that municipality. That same class A customer is registered under Maximum Demand Reduced to Common Basis, and is also represented as 11 h.p. Now the final load upon which the power department is prorated with the others is 187 h.p., and the 11 h.p. is still in there unreduced. It also appears as 11 h.p. in the preliminary chart reading taken off the charts, and represented in the very first column in the 222.6 k.w. There is no reduction in the demand of class A customers. It is a constant figure throughout.

MR. G. J. MICKLER, H.E.P.C. of Ont., Toronto: The total of the individual loads, power and waterworks, street railway and lighting, shown on sheet No. 1 in the ordinary case would be much greater than the actual peak billed by the Hydro Commission, depending upon the diversity between that total and the total amount of power billed,—depending upon the relation between the total of the individual peaks charged to the departments and the total power billed by the Hydro-Electric Commission. I venture to say that in this particular example, while the total amount of power charged to the departments is 553.9, the average power bill of the municipality would be much less than that, perhaps 550 or down to 500 k.w. This has been found in working out many analyses.

Low Power Factor—Causes and Remedy

By C. E. SCHWENGER, Distribution Engineer,
Hydro-Electric System, Toronto.

POWER Factor may be expressed as the ratio of power current to total current, or what is equivalent, the ratio of kilowatts to total kilovolt amperes expressed as a percentage.

The total or line current may be looked upon as being made up of two components, a power component which is in phase with the voltage, and a reactive component which is 90 deg. out of phase with the voltage. This reactive component may be either 90 deg. behind of 90 deg. ahead in time relation to the voltage and is then said to be "lagging" or "leading" the voltage respectively. Currents having lagging components produce "lagging" power factor and those having a "leading" component produce leading power factor.

Inductive apparatus such as induction motors and transformers take currents having a lagging component and thus produce lagging power factor. Condensers, either synchronous or static, take currents having leading components, thereby bringing about leading power factor conditions.

Non-inductive apparatus such as incandescent lamps and heating devices take currents from the line which have no reactive component. The current in this case is said to have a power factor of 100 per cent, or unity, in other words it is made up entirely or 100 per cent. of power current component, i.e. current in phase with the voltage.

Fig. 1. shows the reactive component at various power factors in reactive volt amperes per 1000 watts, (or kilowatt).

Since at 100 per cent. power factor there is no reactive component we have here the case where, for any given power supplied, the current flowing is a minimum. At all other power factors the current flowing in the line is increased over this minimum amount by the

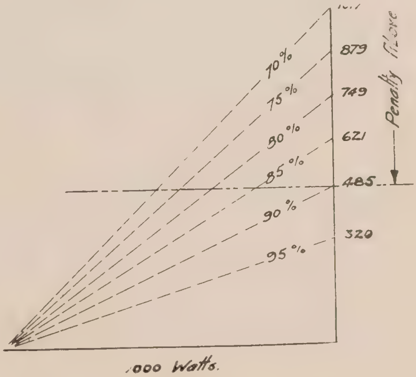


Fig. 1

geomatric addition of the reactive component to the power component. This produces a current always larger than that flowing at 100 per cent. power factor. In other words we deliver at the power factors lower than 100 per cent. the same amount of power but with a greater line current.

It is obvious that on account of this larger line current we will have to use larger wires, larger transformers and generators, in fact every apparatus through which the current flows will have to be of larger capacity than if operated at 100 per cent. power factor if same losses are to hold or if same efficiency is to result.

Looking at it another way we find that generators, transformers, motors, etc., are rated on their current carrying capacity or in kilovolt amperes capacity. Since the kv-a. capacity required to supply any given load is increased as power factor departs from 100 per cent., it is obvious that any given device with definite kv-a. rating cannot carry as much energy at low power factor as at 100 per cent. power factor. For this reason it has been found necessary to eliminate this wasteful loading of equipment by improving the power factor or in other words by using energy at lowest kv-a. draw on the apparatus possible.

Power contracts, therefore, provide a charge for this wasteful use of equipment by an extra charge for energy when taken at low power factor. In this way investment and operating charges on equipment so tied up are met.

In Ontario where power is charged the Municipality on peak basis this wasteful use of equipment is taken care of by charging additional for power consumed at power factors less than 90 per cent. This charge is made on basis of 90 divided by actual power factor (when less than 90 per cent.) times the actual peak kilowatts (or horsepower).

Power Factor.	R.K.V.A. Wattless Component Per K.W.	R.K.V.A. Causing Penalty.	K.W. Penalty.	Ratio K.W. Penalty / R.K.V.A. Causing Penalty.
100	0	0	0	0
95	320	0	0	0
90	485	0	0	0
85	621	136	58	42·7
80	749	264	125	47·4
75	879	394	200	50·8
70	1017	515	286	55·5
65	1171	686	383	56·2

Fig. 2

Referring to Fig. No. 2 we have data as to the magnitude of this penalty on the above basis at various power factors. A comparison is here shown between reactive component causing penalty and the actual penalty. This comparison shows that all reactive volt amperes in the load at power factors lower than 90 per cent. are paid for on the basis of approx. 50 per cent. of the prevailing power rate, the range being from 42.7 per cent. at 85 per cent. power factor to 56.2 per cent. at 65 per cent. power factor. It is close enough for this discussion to say that the penalty is 50 per cent.

of prevailing energy rate. Thus for Toronto where prevailing rate is $24.00 per horsepower per annum, or $32.00 per kilowatt per annum, we are able to valuate reactive kilovolt amperes causing penalty at $16.00 per reactive kv-a. per annum. If therefore we have large reactive kv-a. components in our loads the penalty becomes one of very considerable importance.

I shall endeavour to list some of the causes of lower power factor looking upon the subject more as a system problem as well as to suggest remedies for it. The same line of reasoning will apply to power factor of system units such as feeders, stations, etc., or to individual consumers' plants.

Therefore let us consider that loads under 90 per cent. power factor be classed as low System Power Factor since under such conditions the system is penalized.

Causes of Lagging Power Factor.

As mentioned above inductive apparatus produces lagging currents. We have in order of importance the following:—

Induction Motor Loads.

Transformers and other inductive apparatus such as meters, vibrators, rectifiers, etc.

Induction Motors.

Induction motors usually operate as such under all conditions of loading as loads having lagging power factor. The power factor varies also with the loading of the motor.

Fig. 3. shows the characteristics of a typical induction motor one of 50 h.p 550 volt, 3 phase, 25 cycle, 750 rev. per. min. at different loadings and also at voltages 10 per cent. above and 10 per cent. below normal rated voltage.

From this table it is seen that motors operated at light loads have inherently lower power factor than at full load. In other words motors put in too large for their job are a great detriment producing as they do both low power factor and low efficiency. This putting in of motors too large for their job is known as over motoring. Over motoring is unfortunately a very common practice and should be discouraged. Smaller motors should therefore be installed where there is over motoring. A great deal can be accomplished by doing this in consumer's plant in which case not only is the consumer's power factor increased and his penalty is decreased, but also the system power factor is improved and penalty decreased.

Volts		½ Load	¾ Load	4/4 Load	No. Load Amperes
495	Efficiency	86.9	87	85.8	
	Power factor	79.5	86.9	90.3	19.2
550	Efficiency	86.6	87.7	87.3	
	Power factor	70.3	81.5	86.6	21.6
605	Efficiency	86.3	87.9	87.8	
	Power factor	55.5	68.5	76.3	32.0

Fig. 3

The Table Fig. No. 3, suggests a cure for over motoring and that is to operate at slightly low voltage. Underloaded motors show considerable improvement in power factor at low voltage. There is under these conditions a slight decrease in motor efficiency. This however is not recommended as fully loaded motors on the same circuits would then show an overload. On the other hand high voltage in every condition of loading greatly reduces the power factor. The remedy is obvious. High speed motors also show better power factor than those of lower speeds. It is therefore desirable to use motors having as high a speed as practically possible.

When loads having leading power factors are injected into a system having lagging power factor, the reactive component of the leading power factor load is opposite to the reactive component of the inductive load and counteracts it. Using condenser equipment on consumer's plant where motor loads prevail will reduce the lagging reactive component and improve the power factor. I shall discuss this further under system power factor improvement.

Motors themselves also have varying characteristics and only motors which operate at high power factor and efficiencies should be used whenever possible. Also as shown above motors which are operated at voltages above their normal rating should not be used. In many cases where motors are not standard but are rewound or second hand with unknown ratings, we are liable to get motors on the lines which are extremely bad offenders. I refer to the use of say a 440 volt motor on 550 volt circuit. This is occasionally done deliberately, a simple change on the nameplate and a 440 volt motor becomes one for 550 volts. The consumer does not know the difference. Such motors under no condition of loading can give good power factors. Normally 550 volt motors of poor design when operated at even 575 volts will produce low power factor. Such conditions should be very closely looked into. As motors are usually in consumer's plants it is good business to keep the consumer well informed on this subject as any benefit he may derive through power factor improvement is also enjoyed by the System.

Transformers.

These are largely system devices and affect power factor. Also where used on consumer's plant they affect consumer's power factor. Distribution transformers supplying residence consumers and power loads have a wide variety of exciting current values.

Transformers of 5-10-15 or 20 kv-a. of the standard types of a few years ago had exciting currents of from 6 per cent. to 10 per cent. of full load current. These transformers have a normal voltage rating of 2200 volts primary and 110/220 or 550 volts secondary. Such transformers are usually operated on voltage raising taps so that 120/240 or 600 volts would be delivered by the transformer to the network which after allowing for secondary line, service line, and interior wiring voltage drop, allowed 115 volts to be delivered to the consumer's equipment. Transformers so

operated are over excited and would have exciting currents ranging from 15 per cent. to 40 per cent.

These exciting currents are active in affecting power factor and are present regardless of the load on the transformer.

We have record of certain older transformers when operated 10 per cent. above normal voltage rating having considerably over 100 per cent. full load exciting currents thus at no load we have a kv-a. load on the lines of 100 per cent. of transformer rating. This transformer when fully loaded with 100 per cent. power factor load such as lamps would have a power factor of 70 per cent. The reactive component injected into the system by transformer exciting current is in reactive kv-a. approx. the rating of transformer multiplied by the per cent. exciting current.

It is therefore recommended that transformers having small exciting current values only be used. Transformers to meet this condition should be rated 2400-120/240 or 600 volts and at that voltage rating should not take much more than 2 per cent. exciting current.

Thus take a system having say 250,000 kv-a. in transformers

125,000 kv-a.	13,200 volts to 4100 in sub-stations
125,000 kv-a.	Distribution transformers
250,000 kv-a.	

If we allow only 10 per cent. exciting current due to over excitation we have a reactive kv-a. component of 25,000. If 2 per cent. transformers are used exclusively this reactive component is cut down to 5000 reactive kv-a. We thus save for the System 20,000 reactive kv-a. which might cause penalty and which would require this capacity in corrective equipment to eliminate.

Thus 250,000 kv-a. in transformer capacity gives reactive kv-a. components of

At 10 per cent. exciting current	25,000
At 6 per cent. exciting current	15,000
At 2 per cent. exciting current	5,000

This shows that power factor can be greatly improved by using only transformers having the lowest exciting currents.

Another bad offender from a power factor view point is the constant current transformer for supply of street lighting series circuits. These transformers when fully loaded have a reactive component 100 per cent. of the power component and produce including full load (non-inductive) only 70 per cent. power factor. When therefore a large capacity in constant current transformers is installed they should be selected with lowest possible magnetizing currents. Such transformers should at all times be well loaded because their bad power factor characteristics are considerably aggravated at partial loads.

Miscellaneous Causes.

It might be interesting to examine the possible effect on power factor due to the load of shunt coils in induction watt hour meters. They have in the shunt circuit a loss in 110 volts coils of approx. 1.5 watts at 20 per cent. power factor.

If we have 125,000 meters we then have a watts loss of 187,500 or 187½ kw. This load at 20 per cent. power factor has a reactive component of

920,000 volt ampere or 920 reactive kv-a., and if causing penalty produces a rather surprising amount.

Care should be taken to place only induction meters on the line having highest power factor in shunt circuit. I have not collected data on this point but would like to have it discussed as I introduce it here to show how apparently small factors when present in large numbers become a considerable item.

Other inductive equipment such as voltage regulators should also be chosen with a view to producing the least effect on power factor of the system.

Corrective Equipment.

I have above indicated that devices having a reactive component "leading" when used on a system of low lagging power factor improve the power factor by reducing the size of the lagging reactive component. Condensers either synchronous or static produce such leading reactive components.

Synchronous condensers are very effective and when installed in units of large capacity will produce leading reactive components for from $4.00 to $6.00 per reactive kv-a. with power at $32.00 per kw. per year. When thus used on a system we are able to cut down the reactive kv-a. penalties from $16.00 to $4.00 or $6.00. We now are able to valuate reactive kv-a. penalties at the lower figure. This is a decided improvement over non corrected penalty which as pointed out above costs $16.00 per reactive kv-a. The synchronous condenser however should not be looked upon as a "cure all' for low power factor. It simply makes the penalty smaller but does not entirely eliminate it since you cannot eliminate the cost of condenser operation.

Static condensers although not yet commercially available at 25 cycles will also produce leading power factor components. However if used they would simply reduce the penalty in much the same manner as the synchronous condenser.

There is also a recent arrival in the field of a self excited synchronous motor made in small sizes at 60 cycles. This has a promising field of use in consumer's plants. This motor although having induction motor driving characteristics has leading power factor component and would improve power factor much the same as a synchronous condenser. It is now being developed, I understand, for 25 cycle operation. This motor will operate where any standard induction motor now operates and if put on the market at a reasonable price should help greatly in producing better power factor.

In concluding it should be noted that apparatus producing low power factor should be eliminated as much as possible rather than to use remedial equipment to correct conditions which might just as easily have been left out in the first place. Much can be accomplished if we *use good induction motors.*

Prevent Over Motoring.

Use *good transformers with low exciting* currents load transformers efficiently or prevent over transformering.

Discussion

MR. J. A. HARRIS, Toronto: There is the matter of correction of power factor on the premises of the consumer. I think that is the most economical method whereby that can be accomplished, because we reduce his investment rather than increase it.

We had a consumer using a load of about 2,000 horse-power, with a power factor running around 65 per cent. He had to increase his plant considerably, and by changing a number of the groups of motors from the old plan he was able to raise the power factor from 65 to 85. There was also a synchronous set installed, but a great deal of the improvement was accomplished by the changing around of the motors and getting the proper size installed.

In another case of a smaller plant, where a consumer had 118 horse-power, he had to increase the size of his plant. By changing the grouping and loading of his motors he materially decreased what he would have had to install, and his power factor was raised to about 85 per cent., from around 70 per cent.

There are other things to which we have to give consideration in the raising of the power factor on the consumer's premises; but it appears to me, the most important step in trying to improve the power factor is to obtain apparatus which will be conducive to a high power factor.

I might take the liberty of even suggesting that the Fynn Weichsel motor is one of the outstanding developments of this year along those lines.

I would like to ask Mr. Schwenger a question, the answer to which would be of interest to many. When he speaks of installing the power factor corrective equipment on the central station end, I would like to ask how far-reaching it is in its effect on the system?

MR. SCHWENGER: Before answering the last question, I would like to point out, in connection with that 2,000 horse-power connected load, that in addition to the elimination of considerable over-motoring in that plant, it was found that the consumer, who was buying power at 12,000 volts and stepping it down in his own transformer, was using too high a voltage on his motors; and by lowering that he improved the power factor.

In regard to the question as to how far-reaching corrective power factor equipment is, I might say it has its greatest effect where it is in the consumer's plant; that is, it reduces the current in the consumer's wiring, in the transformer and has its effect through the sub-station transformers back to the source.

THE PRESIDENT: Mr. Schwenger in his paper made mention of a motor being developed. I understand Mr. Ewings, of the Wagner Motor Company, is in the room. He might possibly wish to give some description of the motor.

MR. W. S. EWINGS, Wagner Electric Mfg. Co., Toronto: I did not intend to give any detailed description of the motor, but possibly a few brief remarks about some of its characteristics might be interesting to the gentlemen who are not familiar with it. As Mr. Schwenger pointed out, the synchronous condenser is of course an effective power factor corrective; but as such machines are usually made in large sizes it is only suitable for application at some central point in the distributing system or in plants which have pretty large connected loads. It does not help out the case of the smaller industrial plant where the total load is not sufficient to warrant the expenditure required to put in a machine of that class. For small plants, the static condenser has been about the only corrective means, and that, I believe, is not available in 25 cycle equipment.

The new type of motor which has been mentioned is made in sizes as small as 5 horse-power, so that it works in just as well in the small industrial plant as it does in the very large plant. I might call it a self-excited synchronous induction motor, as it combines the characteristics of the ordinary induction and synchronous motor, and the starting current and over-loading capacity of any good slip-ring motor; but it operates at a synchronous speed, instead of at only about 95 per cent. of synchronous speed, as an induction motor does. When the motor comes up to the synchronous speed, it will carry up to 150 per cent. load.

As it is ordinarily designed for use in conjunction with other motors the Fynn Weichsel would have a leading power factor of somewhere around 50 per cent. or 55 per cent. at low load; 90 or 92 per cent. leading at full load; the curve gradually slopes down and unity power factor is reached at about 165 per cent. load. After a load of about 165 per cent. is reached, the motor does not fall out of step and stop, as an ordinary synchronous motor does, but beyond that point it continues to operate just as an ordinary slip-ring induction motor and with a lagging power factor similar to that of any standard induction motor.

Both Mr. Schwenger and Mr. Harris have pointed out the desirability of preventing over-motoring in a consumer's plant. Naturally, that is very important, but it is a pretty hard proposition to take care of that, in many cases, because industrial conditions change so much that a motor which is now loaded up to full capacity may be carrying only 25 per cent. load next week. That renders it very difficult to take care of the over-motoring condition in the average plant. In a plant where motors of the Fynn Weichsel type are used in conjunction with other motors, I think over-motoring is not such an important factor, because the leading power factor characteristics of the Fynn Weichsel enables it to compensate for the lagging power factor of the induction motor.

From a customer's standpoint, a motor of this type seems to be a good proposition, because it not only gives a power factor corrective but at the same time gives him a motor capable of handling any type of constant speed load. It has all the operating characteristics of the regular slip-ring motor; incidental, of course, with the power factor corrective feature there is also the voltage regulating feature.

The same thing applies, of course, from the central station standpoint, but there you have the important feature that the power factor correction is taken care of in the consumer's plant, which is the logical place for it; and in that way you get the improved conditions so far as line losses and transformer capacity and all the rest of it are concerned.

These motors have been in service now for a number of months; but up until the present time 25 cycle ratings have not been available. They are now under construction and, I believe, that in the very near future there will be 25 cycle machines on the market.

MR. H. O. FISK, Peterboro: After all, is not the kv-a. meter the answer to this whole situation? Kv-a. is what we are selling, and that is what our consumers are taking. The average consumer seems to think it is well to get a motor a little larger than his actual needs. I think the average consumer always has it in his mind that his business will grow, and that when buying a motor now he would do well to have it a little large. If he is bound to persist in it, why not put in a synchronous motor in your station, take your kv-a. meter readings and make money?

MR. E. M. ASHWORTH, Toronto: I am very much interested in what Mr. Fisk has said, and in a measure he is very correct, too. There is just one point, that the kv-a. meters do not measure cost, that is to say the reactive component does not cost you as much as the power component. Why should we try to get a meter that will automatically perform the mixing up of those two elements, reactive current and real power, when they really should be studied separately? That is to say, reactive power costs $3 or $4 a horse power to supply. Real power costs—it is a little doubtful now about just what it costs.

To my mind if you are going to measure kv-a. and bill on that exclusively, you are penalizing the man who gets an induction motor with a good air gap, a good safety capacity, and also the man who is working nights, perhaps, when the voltage is high and the power factor is low. During the war there were some men who would put on a high peak and made a lot of money for us, while the power during the night hardly cost us anything.

It should not be a very difficult matter to study out the respective power component and the reactive component for all the different power factors from 100 down to 50. Take, for instance 70 per cent. power factor, your reactive component is equal to your power component. I think it would be a very pretty subject for the

Rate Committee to work on and prepare a table of proper corrections for power factor which you could consult and which would enable you to charge a customer in such a way that he would be paying at cost for what he got. That would remove the evil or make it so that it would no longer be an evil.

Some man might prefer to have a low power factor, as it might suit his requirements. He might want to have a little motor for every machine, which is very much discouraged by the kv-a. meter readings.

It seems to me that the devices which are advocated for correcting power factor are all in the wrong direction, in the direction of a very small air gap, of a motor that is too small and a lowering of the voltage, which will tend to burn out your motors. All these things are sacrificing what is really good, safe engineering practice, for raising the power factor and cutting down the power factor cost.

MR. M. J. McHENRY, Ferranti Meter and Transformer Co., Toronto: Up to within the last few years the question of power factor has been largely neglected by the central stations in the United States and Canada. Recently it has been given very careful consideration, and I think probably one of the reasons why it has been given consideration is due to the fact that all equipment installed by central stations has cost considerably more since the War than it did before; and that raises the cost of supplying the reactive component.

Mr. Fisk, of Peterboro, raised the point as to why we should correct the power factor at the consumer's premises, and not bill the consumer on a kv-a. basis, or have him pay for both the power component and the reactive component, and correct it at your own station, thereby reducing your own penalty. That does not work out to the advantage of the central station, because it neglects entirely the capacity that is necessary at the central station to supply the individual consumer.

If an industrial plant has a power factor of 65 per cent., the reactive component for which he is penalized is approximately 60 per cent. of the power component. That means that for that particular customer the transformer capacity and meter capacity is 60 per cent. greater than would ordinarily have to be supplied, and the central station has to make that additional capital expenditure to supply that customer; and that is entirely unnecessary in a great many cases.

To the individual consumer, the question of his power factor and the remedy to be applied, if he has a low power factor, cannot be generalized. I think it is a question of looking into the individual consumer's proposition and analyzing it individually for each proposition. It has been already pointed out by Mr. Schwenger and several other speakers that a great deal can be done by preventing overmotoring, and by re-arranging or regrouping the motors and machines in the customer's plant in such a manner that his power factor may be very materially lowered. I have in mind a case of a plant which had a load of approx-

imately 150 kw., and a power factor of about 68 per cent., which plant was supplied through a bank of transformers totalling 150 kv-a. Now the bank in question, in order to carry that load, had to carry about 250 kv-a., and the transformers supplying that had to carry that overload. By re-grouping the motors and the machines, the power factor was increased to 85 per cent., and he had two motors put out of operation, and carried them as spares. That can be done in a great many existing plants, and can be accomplished with very little expense to the consumer and with very great benefit to the central station. In other plants it may not be found possible to correct the power factor in that manner.

A point has been raised in regard to plants where they desire individual drive for all their machines. In that case it is a difficult proposition to correct the power factor by switching motors, and it is almost always necessary to install some extra corrective apparatus, such as static condensers or synchronous condensers. At the present time the development of the synchronous condenser is very rapid; and I may say that at the present time a synchronous motor has been developed in ratings from 50 horse-power up, which will be as easily applied as the standard induction motor. To do away with the usual complications involved in synchronous motors, equipment is supplied with a hand-operated starter, and it is simply started and operated as any other induction motor on the market to-day. I think there will be a big field for synchronous motors of this type in ordinary industrial plants.

In regard to reactive load imposed on the system by the shunt coils of watt hour meters, Mr. Schwenger has pointed out that the power factor of the shunt coils is approximately 20 per cent. I have not made a study of all meters and possibly his percentage may be an average. I know that in certain meters the power factor is considerably higher than that. In one particular meter which I have in mind it is approximately 40 per cent., and I thought that probably the average percentage would be nearer 30 per cent. than 20 per cent.

If the individual central stations will take the time to analyze the conditions in various consumer's plants where they are suffering from low power factor conditions I feel sure that in almost every case they can take the matter up with the consumer and point out to him where he is losing money and where the central station can be very much benefited if changes are made; and I think it is certainly good engineering practice to analyze these conditions and to try and remedy them. We are all working towards high efficiency from every standpoint and I personally feel that the idea of allowing a plant to go along with a 60 or 65 per cent. power factor and penalizing it on its low power factor is a wrong idea.

MR. G. N. BRACE, Canadian General Electric Co., Toronto: There are just two points in which I was specially interested, the question of the voltage to be applied on transformers, and the question of the proper value of exciting current.

We, as manufacturers, of course have subscribed to the Canadian En-

gineering standards. The voltage there was fixed at 2,200 volts; but we have found by actual practice that many municipalities are asking for 2,400 volt stock. That means that we have to carry two different standards, and that the cost of production goes up. We are quite agreeable to manufacture any voltage that is required, but we would like to settle on one voltage, if that can be done.

Mr. Schwenger puts the exciting current which should be allowed at two per cent. In the larger size of transformers that is quite feasible; but when you get down to the smaller transformers it is quite a different proposition. If you take the 25 kv-a. transformer, to reduce the percentage, costs in the neighbourhood of $10. In Toronto a $16 reactive kv-a. nets you a difference or a saving in penalty of about 85 cents a year, and with compound interest it would take you from 15 to 20 years to save the $10, even under maximum conditions. Therefore, it would appear that even under the worst conditions you are paying rather excessively for the slight losses of excited current. I think it would be of great benefit to everybody concerned if there should be some new arrangement, especially in regard to 25 cycle districts,—it does not apply so much to 60 cycle districts,—if the manufacturers and the municipalities could get together once again, either in or out of the Engineering Standards' Association, and decide upon one voltage, and while it cannot be decided exactly what exciting current can be given, there could be a better understanding in that regard.

MR. S. L. B. LINES, Lincoln Meter Co., Toronto: With regard to the volt ammeters and the power factor, I suggest it is not much good to simply go after the power factor. It would seem to be very much better, instead of getting at watt ratings or a power factor rating if you would go right at it and work it out.

I think it might be interesting to know that the Canadian Electrical Association at their Convention brought in Mr. Fisk's suggestion that all power factors should be measured on a straight kv-a.

MR. JOS. SHOWALTER, Canadian Westinghouse Co., Toronto: A meter is a bit of apparatus that we can afford to have a wattless component to. The wattless component is what gives the meter its kick. If we had a meter from a designer's point of view it would have a zero power factor. If it had a hundred per cent. power factor, it would not go at all, it would not have any kick.

MR. C. W. BAKER, Packard Electric Co., St. Catharines: I think it is a mistake to consider this matter of meter loss as a matter of power factor; it should be done as a matter of reactive watts. As Mr. Showalter says, from the designer's point of view we design a meter to have as low a power factor as possible. Mr. Schwenger's view appears to be to have as high a power factor as possible. The real common ground is to have as good a meter as we can get. If we get too high a power factor, we are apt to require too much compensation in our meter, and it is quite possible to affect the meter's performance. In a very broad way, the lower the power factor the better the meter's performance.

Induction Regulators—When are these Necessary and Where Should They be Installed?

By F. F. AMBUHL, Assistant to Chief Engineer, Hydro-Electric System, Toronto.

VOLTAGE regulation is a problem which has confronted the managers and engineers of Distribution Systems from the beginning of the electrical industry. The ill effects of fluctuating voltage is becoming more generally realized by the public and perhaps no other phase of the service more easily tends to create dissatisfaction among light and power consumers than fluctuating voltage.

On a large and extensive system, such as the Ontario System, the subject of voltage regulation often becomes an important problem. The various steps of transformation, long lines, characteristics of the lines, and character of the load, all have a decided effect on voltage regulation. The quality of service cannot be considered satisfactory unless the voltage regulation is satisfactory and while continuity of service is generally recognized as the prime requisite, the quality of service is next in importance.

The value of good voltage regulation depends on the purpose for which power is used and probably has its maximum value in lighting.

The percentage of power used for lighting by the different municipalities, varies considerably, though, the incandescent lamp is used to a greater extent and by a far greater number of consumers than any other electrical device

Voltage variation has a greater effect on incandescent lamps than any other electrical device, and for this reason and on account of its extended use, the public to a very great extent judge the efficiency of a system's supply by the quality of the lighting.

Such appliances as electric ranges, flatirons, toasters, hot water boilers, percolators, warming pads, etc., also make up a considerable load and require nearly as close regulation as incandescent lamps for their satisfactory operation.

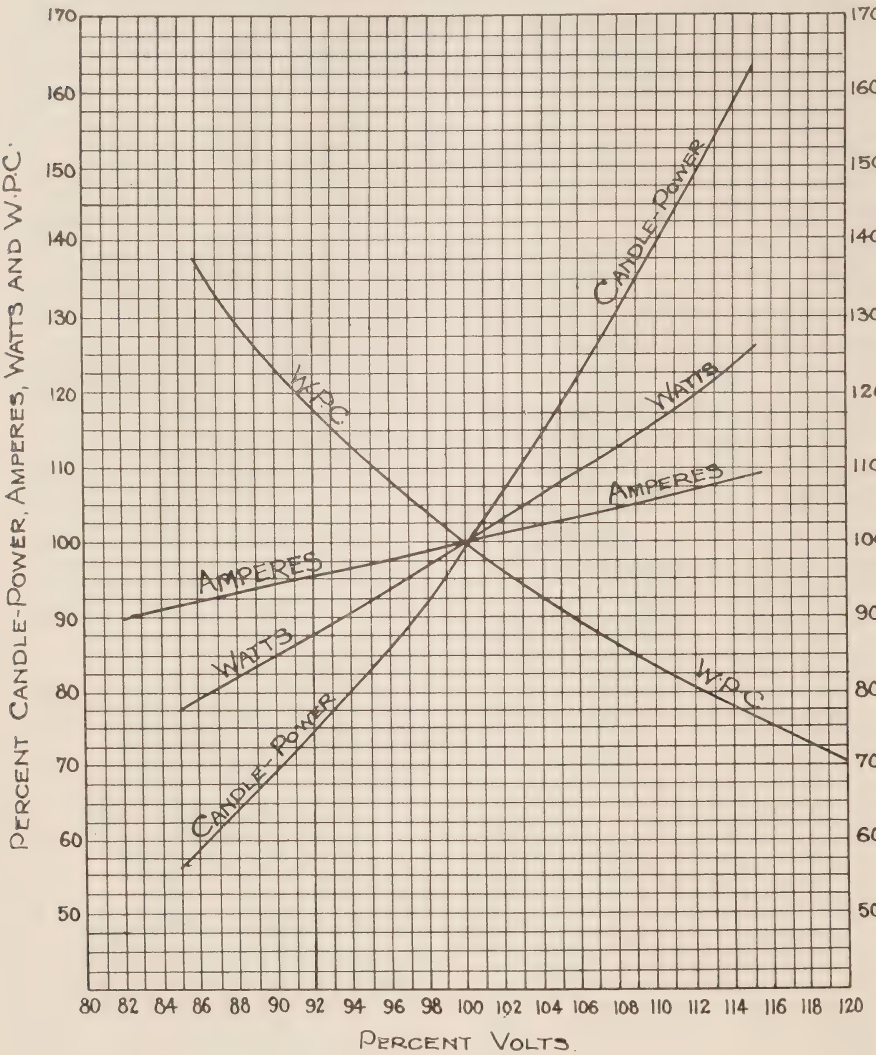
In practically all heating devices, the power consumed varies approximately as the square of the voltage applied; thus, if the voltage drops five per cent. the power consumption will be reduced nearly 10 per cent.

No doubt the cause of many complaints, received from customers, that their electrical devices are unsatisfactory, are traceable to low voltage.

In this particular field, as in the case of lighting, good voltage regulation will go a long way toward keeping the consumer satisfied.

The effect of a variation in voltage on the candle power of incandescent lamps is shown on Fig. 1.

It will be noticed from this, that for



SHOWING EFFECT OF VOLTAGE VARIATION.
CHARACTERISTIC CURVES OF MAZDA LAMPS
Fig 1

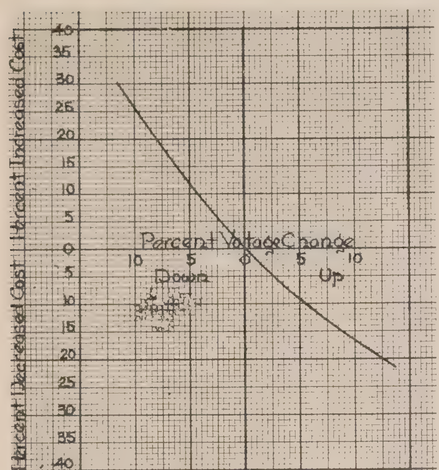
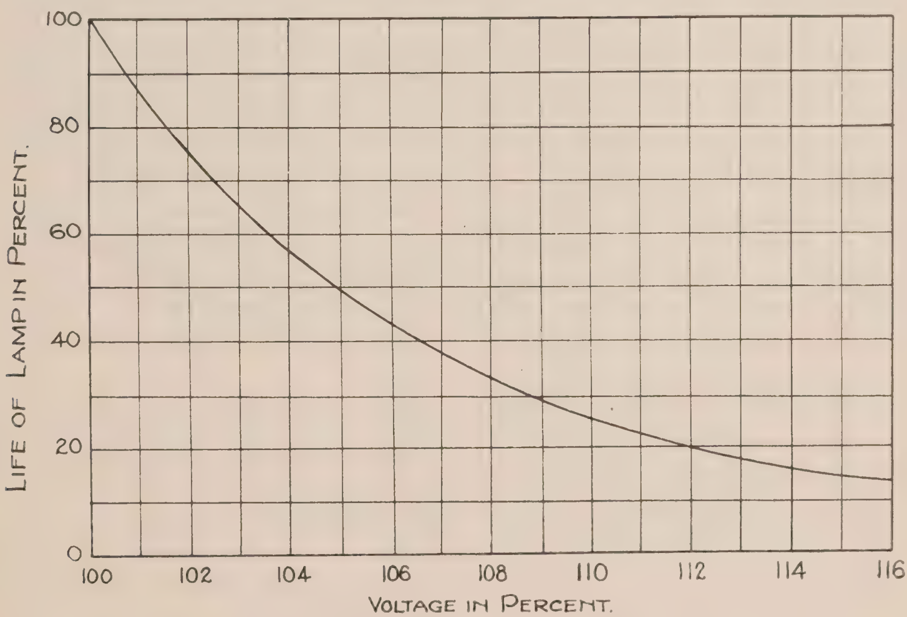


Fig 2.
Relation Between Cost of Illumination and Voltage of Mazda Lamps Based on assumption that cost per candle-power at 100 percent voltage, is also 100 percent.

each per cent. variation in voltage, there is approximately 3½ per cent. variation in candle power; for instance, if a feeder has 4 per cent. variation in voltage (2 per cent. plus or minus) there will be a variation in candle power of approximately 14 per cent. It will be seen from this that with a lower voltage, the cost per candle power increases and with a voltage above normal, the cost per candle power decreases. This is of course, based on the assumption that the cost per candle power at 100 per cent. voltage is also 100 per cent. (see Fig.2).

One might assume from this that it would be more efficient to operate incandescent lamps at a voltage above normal. By referring to Fig. 3, it will be seen that a variation in voltage



Relation of Lamp Life to Voltage
Average Performance of Tungsten Filament Lamps.

Fig 3.

greatly effects the life of incandescent lamps and that any increase of voltage shortens their life rapidly. The voltage rating of the lamp is therefore based on the cost of the lamp, its average efficiency, and cost of power. This can however, only be determined approximately.

The amount of power consumed by an incandescent lamp, as shown on Fig. 1, also decreases rapidly with decreased voltage and varies in the proportion of approximately 1.6 per cent. power for each per cent. voltage. Voltage variation also has a considerable effect on the revenue obtained. Assume for instance, that 40 watt lamps are the average size and that 1000 hours per year is the average service also that the power rate is two cents per kw. hour. Then for each per cent. drop in voltage, there is an annual loss in revenue of 1.28 cents per lamp. On the assumption that the average voltage is 3 per cent. low, the annual loss to the Distribution System in lighting revenue would be 4.8 per cent.

Since raising the voltage would increase the peak load, and if power is paid for on a peak basis by the municipality, it will be seen that this would to some extent off-set any gain in revenue on account of its effect on the peak load. If, however, the system peak does not occur every month during the lighting period (say between 6 p.m. and 11 p.m.) there would in all probability be a balance in favor of the regulated feeder.

On the basis of the above, the difference in increase cost for power and increase revenue per lamp per annum for each per cent. rise in voltage, is only a fraction of a cent. and may be either in favor or against the regulated feeder, depending on the time of the system peak, diversity of the lamp load, and power rates. But in any case it is a very small percentage of the total lighting revenue. This is on the assumption that the municipality pays $30.00 per kw. year for its power.

The object, however, is to regulate the voltage and thereby improve the service, though this cannot be obtained without the expense of regulating equipment to compensate for the variation in voltage.

Assuming a 5 per cent. regulator, 200 Amperes, 2400 volts having a range of 5 per cent. buck or boost to cost $2,000.00, that the fixed charges are 12 per cent., that the losses in the regulator during peak load is 4 per cent. and that the municipality pays for its power on a peak basis at the rate of $30.00 per kw. year, then the total annual fixed charges less installation cost is approximately $270.00.

The question arises as to whether the increase in voltage should be obtained by increasing the line copper or installing a regulator.

This depends on the relation between :—

The cost of additional line copper sufficient to reduce the voltage drop of the line to a permissable amount plus the line loss, and:

The cost of a regulator plus the cost of the losses in the regulator and in the line.

It must be remembered, however, that this has reference only to a rise in voltage to compensate for line drop,

and that the increase in copper, not only does not eliminate the voltage drop entirely, but does not take care of voltage variation, either on the feeder or of the supply.

The voltage regulator will give infinitely better results even though the annual charges may be slightly more for a regulated feeder than for additional line copper alone.

As an example, assume two 200 ampere, 2300 volt single phase feeders (480 kv-a. feeder) 1½ miles long, one using 4/0 feeder with a 5 per cent. regulator (24 kv-a.), and another 500 m. cir. mils. feeder without a regulator.

regulated feeder will still be 4 per cent. low, and as there will also be a further drop at the consumer this should be reduced. Now to reduce this drop (4 per cent.) by one half, would require double the copper or an increased cost of $7100.00. On the other hand, if the regulator was placed on the 500 m. cir. mils. feeder the increased cost in investment would be only $2500, and the voltage would not only be brought up to normal at the load centre, but there would be sufficient range to boost the voltage 6 per cent. over normal or take care of any variation in the supply voltage up to this amount.

	500 m.cir. mils Feeder	4/0 Feeder
Voltage Drop	4%	8+%
I^2R loss in Feeder during peak	14.0	32.00
Kw. loss in regulator		1.0
Cost of line @ $ .25 per lb. (Weather Proof)	$7,100.00	$3,150.00
Cost of Regulator		2,000.00
Cost to install regulator		500.00
	$7,100.00	$5,650.00
Saving in Investment		$1,450.00
ANNUAL CHARGES.		
Feeder loss @ $30 per kw. Year acct. peak	$ 420.00	$ 990.00
Plus 10 per cent. Fixed charges on investment	710.00	565.00
	$1,130.00	$1,555.00
Increased operating cost with regulator		$ 425.00

In this example the increased annual operating cost ($425.00) of the regulated feeder does not justify the saving in investment ($1,450.00) from a purely economical point of view, though, with the regulated feeder the voltage at the load centre will be maintained at normal, while the un-

It is interesting to note also that with the regulator installed on the 500 m. cir. mils. Feeder, the total annual operating cost is less than if it was used with the 4/0 Feeder.

It appears therefore, that the copper should be increased to a point where the annual investment charges are ap-

proximately equal to the cost of energy lost in the conductor and a regulator installed sufficiently large to take care of any voltage drop and voltage variation in both the feeder and supply voltage.

Any specific example, however, cannot be used generally as the cost of power, basis on which power is purchased, length of lines, prevailing price of copper, load factor, etc., all must be considered and may change the relation somewhat.

Regulation of Feeders.

The amount of compensation required on a distribution system to maintain constant potential to the individual consumer, depends upon the amount and character of the load and the length and characteristics of the feeders.

Since the peak load occurs at different times on different feeders, it is evident that good regulation of the entire system can be maintained only by the regulation of each feeder independently.

It is the usual practice to establish a centre of distribution on each feeder and regulate for this centre. The results obtained are best determined by taking voltage readings on the secondary side of the distributing transformers located on different sections of the feeder. In Toronto, graphic voltmeters are permanently located on different sections of each feeder and a constant record is kept of the voltage regulation.

In this way any change in the feeder which may effect the voltage regulation, is noticed at once and the regulator adjusted to take care of the changed condition.

Selection of Regulation.

The induction regulator is in effect a variable ratio transformer, its rating being based on its transformer capacity at full load. It is so designed that it will produce a specified range in voltage at full load kv-a. with a power factor of about 85 per cent.

A simple method however, for determining the correct size of a regulator, is to assume that for a single phase regulator, the kv-a. rating is equal to the product of the voltage times the current of circuit times the per cent. regulation. For a three phase regulator the kv-a. rating is equal to the product of the voltage times the current of the circuit, times the per cent. regulation, times the square root of three.

For a single phase regulator the secondary voltage equals the per cent. regulation, whereas, with the three phase regulator, the secondary voltage of each phase equals the per cent. regulation times the primary voltage divided by the square root of three.

The standard equipment for a single phase regulator consists of:—

1. The induction regulator.
2. An operating motor which is usually a polyphase motor equipped with an electrically operated brake and drives the rotor of the regulator through a worm and gear.
3. A primary relay or contact making voltmeter used for energizing the secondary relay.
4. A secondary relay used for energing the operating motor.
5. A potential transformer.

6. A current transformer.
7. A line drop compensator.

The standard equipment for a three phase regulator, is the same as for the single phase regulator except that two current transformers are used in order that at 100 per cent. power factor, a current and voltage may be obtained for the compensator that are in phase with each other and which will result in more correct operation at lower power factor.

Both single phase and three phase regulators have a range twice that at which they are rated, that is a 10 per cent. regulator will boost or buck 10 per cent. giving a range of 20 per cent.

In case of the single phase regulator the variable secondary voltage adds to or substracts from the line voltage in phase with it while in the three phase regulator the secondary voltage is constant for all positions of the rotor but changes its phase relation with respect to the line voltage and in so doing not only changes the value of the feeder voltage but changes the phase relation of the feeder voltage with respect to the bus voltage. The feeder voltage is in phase with the bus voltage only when the regulator is in the full boost or full buck position. Referring to Fig. 4, A.B.C. represents the station bus voltage and $A^1B^1C^1$ represents the feeder voltage with the regulator almost in the neutral position. $A^2B^2C^2$ represents the feeder voltage with the regulator in full boost position, in which case the feeder voltage is in phase with the station bus voltage but higher by the amount of the regulator secondary voltage.

In view of this difference in phase

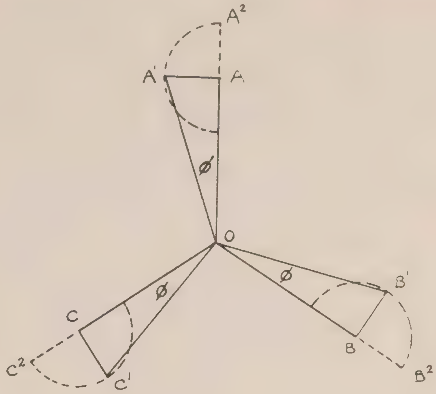
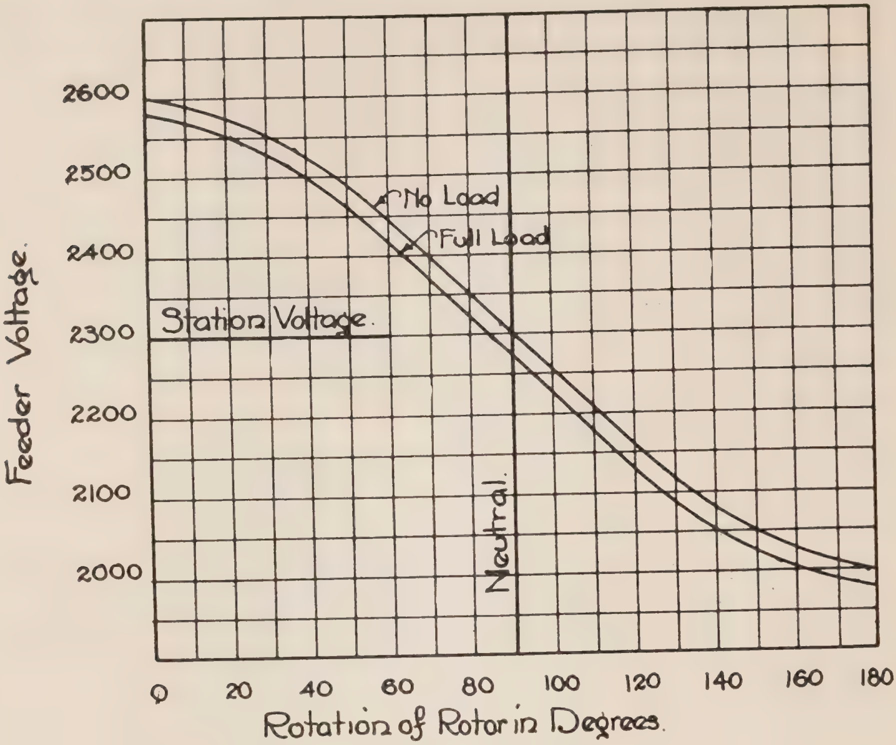


Fig 4
Three-Phase Regulator
Vector Diagram

relation between the feeder and bus voltage when using polyphase regulators, care must be exercised when connecting two feeders together outside for transferring load and in no case should they be tied together unless both feeders have polyphase regulators set by hand, so that the phase relation is the same on both feeders. Unless this is done a heavy circulating current will flow through the feeders, due to the out of phase condition and cause the circuit breakers in the station to open thereby causing an interruption to the service.

With single phase regulators it is only necessary to move the regulators to the neutral position and connect the corresponding phases of the two feeders together. The above applies also when taking a polyphase regulator out of service without interrupting the service.

Figure 5 shows the boosting and lowering of the voltage by an induction regulator. It is customary with some operating companies to equip their re-



Curves Showing Boosting and Lowering of Feeder Voltage by an Induction Regulator

Fig 5.

gulators with a scale or indicator which automatically shows the boost or buck position of the regulator at any time and which may be logged along with the switchboard meter readings. In this way the proper automatic operation of the regulators is continually checked.

Effect of Regulators on Feeder Voltage.

Assume that it is desired to regulate a three phase, three wire, 2300 volt, 100 Ampere feeder and that 10 per cent. regulation is required.

(a) One, three phase 10 per cent. regulator, rated 40 kv-a. 2300 volts, 100 Amperes will produce 10 per cent. buck or boost in the feeder voltage and is entirely satisfactory when the feeder is balanced. On unbalanced feeders however, the three phase regulators are not entirely satisfactory as all three phases are raised or lowered alike and as polyphase regulators are controlled by the

primary relay a single phase device, all three phases are effected by any change in voltage of the phase, across which this relay is connected.

(b) Two, single phase 10 per cent. regulators rated 23 kv-a. each, 2300 volts, 100 Amperes will produce 10 per cent. buck or boost in the feeder voltage and will give fairly good results on unbalanced feeders when the unbalance is not great. Two single phase regulators cost approximately 15 per cent. more to install than one three phase regulator.

(c) Three, single phase 10 per cent. regulators, same as the two described above, would produce 15 per cent. buck or boost in the feeder voltage and will give perfect regulation on all phases, regardless of any unbalanced condition within the range of the regulators. In this case, however, three 7½ per cent. regulators would answer the purpose.

(d) On a three phase, four wire feeder it is necessary to use either a three phase regulator or where the feeder is unbalanced, three single phase regulators are required. Two single phase regulators will only regulate two phases of the feeder as the primary coil of each regulator is connected between the neutral and one phase.

REGULATION OF BRANCH FEEDERS.

It sometimes happens that a feeder is extended out to a suburban district, where the feeder is divided into two or more branches, each carrying a different kind of load and perhaps at different times of the day.

Automatic pole type regulators can be obtained and which may be installed on each of the branches. These are designed for out-door service and may be installed on the poles similarly to that of large distribution transformers. While this method of regulation is satisfactory, it is usually found quite expensive.

It is not within the scope of a paper of this kind to make a precise analysis of the many conditions effecting voltage regulation on a feeder, though, if a reasonable amount of care is used in laying out the feeder system and automatic induction regulators installed on each of the primary feeders, very satisfactory results will usually be obtained.

Practically all large distributing systems use induction regulators for their low voltage distribution and which is evident from the fact that the present combined output of two of the large manufacturing companies is over three thousand induction regulators annually, with the number steadily increasing.

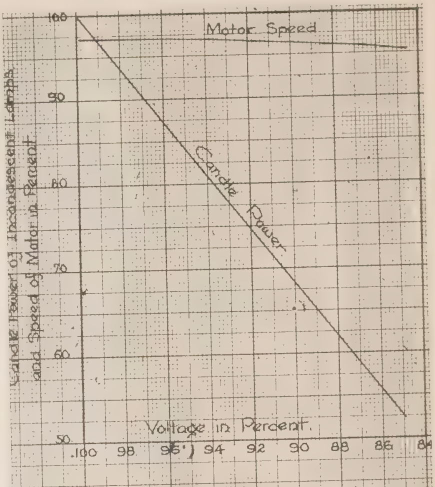
GENERAL CONCLUSIONS.

The amount and cost of regulation will depend on the voltage variation of the power supply and of the feeders, also, on the purpose for which power is used. If a feeder is to supply an industrial load, such as induction motors, a variation of 10 per cent. would not be very objectionable, as this amount of variation in voltage does not cause an appreciable drop in the speed of an induction motor. On the other hand, if the feeder was supplying a lighting load, a 10 per cent. variation (say 4 per cent. in supply, and 6 per

cent. in feeder voltage) would cause approximately 35 per cent. variation in candle power of the lighting.

The comparison of voltage variation on motor speed and candle power of incandescent lamps is shown in Figure 6.

The variation in supply voltage (for municipalities supplied by the H.E.P.C.) is due to the drop in the 110,000 volt lines, 110,000 volt transformers and where a municipality has a 13,200 volt network supplying the various sub-stations, there is also a further drop in this network and in the 13,200 volt transformers before the power reaches the 2300 volt and 4000 volt distribution. Part of the 2300 volt feeder drop may be taken care of by increasing the copper, though this cannot be carried beyond an economical limit. It is evident then, that the most satisfactory method of over-coming the combined voltage variation, is the installation of automatic induction regulators on the 2300 volt or 4000 volt lighting feeders.



Relation of Voltage to Speed of Squirrel Cage Induction Motor and Candle-Power of Incandescent Lamp
Fig 6

Discussion

MR. H. F. SHEARER, Welland: The question of induction regulators is one which is coming more and more to the front in the municipalities where the loads have been increasing. All of us have been faced with the necessity of increasing our load. In connection with this paper I would like to ask Mr. Schwenger how far the change from 2,300 to 4,000 volts has deferred the necessity of installing regulators.

MR. C. E. SCHWENGER, Toronto: In Toronto matters have run so rapidly that we have changed to 4,000 volts, not to prevent putting in the regulators, but because we could not get the feeders in fast enough. In Toronto we have bus variation, and that is one reason why regulators were put on.

MR. O. V. ANDERSON, Toronto: I have heard that there is some doubt as to the operation of three single phase regulators on the system. The point was brought out in Mr. Ambuhl's paper that we will get perfect regulation, and it is true that you do get perfect regulation and on a lighting system you have regulation in a far better manner than you can get in any other way.

Of three-phase regulators it was said it was difficult to tie feeders together,

due to the displacement. If you want to operate on an emergency bus, you are in the same difficulty. In turning one of your feeders over on to the emergency bus, you must get the same phase relation. But with three single-phase regulators you have no difficulty in turning over and it will help you very greatly in the operation of your system.

MR. R. H. STARR, Orillia: In changing over from 2,200 to 4,000 volt connections, how is the consumers' apparatus handled? If a man has 2,200 volts, three-phase, directly connected, how is that taken care of when changing over to 4,000 volts?

MR. SCHWENGER: In answering that for the City of Toronto, I would say that as far as motors are concerned, we have specified districts where 2,400 volt motors will not be taken on; they must be capable of being connected for 4,100 volts. There are very few motors which are not capable of being changed over.

Discussions on Miscellaneous Subjects

"What Methods Are Used For Tree Trimming".

MR. R. H. STARR, Orillia: In 1919, when I went to Orillia, we had trouble on account of the trees, and the Parks' Department would not let us trim them. I wrote around to different places making inquiries. Some said that they kept their poles down so as to have the wires come under the trees. Other places put in high poles. We have both high and low poles. We have some poles where the wires are up 55 feet in the air, and they are interfered with still. Where you let a tree grow up until you have to cut a tunnel through it you meet with difficulties.

We started a campaign, and whenever anybody would call up we would reply that it was tree trouble and the Parks' Department would not let us trim the trees. A few days afterwards I met the Superintendent of the Parks' Department and after that we got permission to trim the trees. We had a representative from the Forestry Department to give us instructions as to how to trim trees. Different trees should be trimmed in different seasons. For instance the maple trees should be trimmed preferably in July and August; and it is with the maples that we are bothered mostly in Orillia.

MR. WILLS MACLACHLAN, H.E.P.C. of Ont., Toronto: I might say that last February we had all the line foremen of the construction department in at Toronto and a representative of the Forestry Department came down and gave them a talk on tree trimming. Then we got a tree in one of the larger rooms in the basement of the annex and had a man trim it showing how to do it.

The Forestry Department has a booklet on tree trimming, which gives a lot of information, and by following it you can have your highway more beautiful and have your trees trimmed at the same time.

MR. H. O. FISK, Peterborough: With us the best results have been secured by building a three wire system under the trees. That allows the trees to grow up as high as heaven or as low down as they want to go. We have also found that the right thing to do is to trim a tree with some idea of the tree itself, not altogether with the idea of the lineman.

Another thing is not to assume that we own the street entirely. Perhaps we do, but it is just as well not to assume that. You will get on just as well if you pull the doorbell and say "Please." Another thing is to get the brush away as quickly as you have it cut off; because it looks big when lying on the ground.

MR. S. B. ILER, H.P.E.C. of Ont., Toronto: We find that there is a difference of opinion among builders of lines as to lowering a line or putting it up in the air. The booklet of the Highways Department shows the trees below the wires, the idea being to trim the tree when it is young and round it out. For myself, I am in favour of the poles with the wires below the trees. I believe you will find somewhat the same difference in regard to this question that we have found in regard to the question of the bare copper wire as against the insulated.

MR. W. K. SANDERSON, St. Thomas: The subject under discussion is a splendid one, because there is no municipality which has not gone up against the question of tree trimming; and there is no more difficult question which a Commissioner has to solve. We have had a great deal of difficulty in our municipality over this question, and we believe that we have overcome it, at least to some extent. There is the manner in which the tree is trimmed and the care which has to be taken of it afterwards. The average line superintendent has not interested himself in that, to any very great extent.

We found that the prestige of our City was becoming somewhat impaired on account of the mutilation of our shade trees. A city without shade trees does not amount to much, in my opinion. Shade trees are the making of the residential portion of any city.

We have transferred the work of the care of the trees over to the Horticultural Society. The people have absolute confidence in the Superintendent of the Horticultural Society, who is one who takes great interest in and makes a great study of and devotes a great deal of attention to tree trimming. The department takes care of the wires and so on. The Council takes care of the tree trimming, and the Board of Works takes care of the carrying away of the branches. In that way we have harmony.

In the first place, it was necessary to educate the people to the absolute necessity of wire clearance; then after that, the proper care of the tree under proper supervision.

* * *

"What Arrangements Are Made For Guy Anchors On Private Property?"

MR. R. H. STARR, Orillia: We try to make arrangements amicably with the party by going in and asking permission; and in the majority of

cases we succeed. When it comes to buying the right to plant a guy anchor, some of them want an exorbitant amount. With us no money has yet been expended.

MR. H. O. FISK, Peterborough: There are three rules, the first is "Keep off"; the second is "Keep off" and the third also is "Keep off". We will not place a pole on anybody's private property especially for his convenience. If anybody wants a pole on his property he has to pay for it entirely, and then he owns it. It is there for his own convenience; and if that property is sold to the first, second or third party, and one of them comes to us and threatens us and says, "Take your pole off", we say "All right. It is your pole." Very often a little study will get around the need for a guy. I do not say that it can be done in every case, but it has been done in some very difficult situations.

* * *

"When Poles Are Moved, Who Pays Cost?"

MR. L. G. EVANS, Toronto: May I ask Mr. Fisk, of Peterborough, what are the conditions under which he would move the pole without cost to the customer?

MR. H. O. FISK, Peterborough: If a man opens up a driveway to a garage or a laneway, we would move the pole six or eight feet, just to clear his driveway. But if he is putting in a gasoline pump for public service or something like that, we make him pay for it.

MR. R. ELLIOT, Galt: By whose permission were these poles placed, in the first place? Was it the City Engineer?

MR. R. H. STARR, Orillia: Answering for Orillia, we place our poles without any instructions from anybody. We try to lay them out to the best advantage, with regard to driveways and front doors. When you are placing poles in front of vacant properties, you do not know what the man who buys the property will want to do with it.

Our idea is that where the pole interfered with a man's driveway we would move the pole; but if it was to beautify the property and to get the pole over to the edge of his lot, the property owner must bear the cost. Personally, I have a pole in the centre of my lawn, and I have put up with it so as not to create a precedent.

MR. W. K. SANDERSON, St. Thomas: Where there is an application from an engineer of another utility to remove a pole, the cost should be included in the cost of the improvement of the street, and consequently we expect that other utility to compensate the Hydro.

MR. C. E. SCHWENGER, Toronto: In the first place, we get the approval of the City Engineer, and as to the line of the buildings. We do not get the location along the line in which to put down the poles. In cases where there is no sign of a driveway when we put in the pole, and a driveway is put in later, the customer has to pay for changing the pole. In the same way, if the City puts in larger curves at intersections, they pay the costs. We do not pay the cost unless the pole has been put in front of a recognized driveway.

MR. S. B. ILER, H.E.P.C. of Ont., Toronto: My practice in two or three

small towns where the distribution system has been built in the last two or three years might be of interest.

Knowing what we might be up against, I have always discussed with the Council, before the work was started, the appointment of some one man as an inspector, a man to be employed by the Council to decree as to the location of the poles. This applies to small municipalities where they have no engineer looking after it. We have it understood that this man's decision should be finally subject to the Council taking up any particular point. To help out the future Hydro Commission later on, it is also made clear to the Council that this inspector's decision as to poles being final, any re-arrangement due to street work or to the desire of individuals shall be paid for by the party asking to have the pole removed.

* * *

"When Houses Are Moved, Who Assumes Cost Of Clearing Lines?"

MR. R. H. STARR, Orillia: In connection with this subject, I might say that the Bell Telephone Company, wherever possible, attempt to collect money for altering the line, where the line is lower than the height demanded by the department or the Railway Board.

The question of who owns the street affects the municipally owned electrical department less than it does the Bell Telephone Company. We have always taken the ground that if our wire was a foot or so lower than the standard called for, we would assume the cost. Where the lines are up the standard height or higher, we charge the party who is moving the house, either the contractor or the party who has bought the house; and we have had no difficulty in collecting so far.

MR. H. O. FISK, Peterboro: There is an Act regarding the moving of houses on highways, as it runs in my mind, although I cannot cite it. I know at one time a person wanted to move an office across the street railway, which involved the cutting of a trolley wire. The result was that he took the chimney off his building and moved it.

MR. C. E. SCHWENGER, Toronto: I do not think there is a rule, as mentioned by Mr. Starr, as to the standard height of wires over the street, except as specified by the Railway Board.

MR. STARR: I am not sure whether it was the Railway Board, but there was some arrangement made, got out by the Hydro, and we have always endeavoured to run our new construction on that basis.

MR. SCHWENGER: So far as we know, there is no rule at the present time. Our lines in Toronto are located on poles not more than twenty feet from the ground, and consequently they cross roadways approximately 18 feet above the ground, or sometimes less. We do not know that we are violating any law or regulation. The owner of the house in all cases has to pay the cost of moving the wires.

MR. STARR: Before the owner can move the house, he has to get a permit from the town or city authorities.

MR. A. O. HUNT, London: We have a local by-law whereby no one

is allowed to move a house before he gets permission. He has to deposit $50 before he can be given permission. We send in our bill and get paid. Lately, however, we have found that $50 was not sufficient, and we are trying to work with the City Engineer so as to arrange that someone shall be sent out to go over the route and make an estimate as to the cost. The Bell Telephone Company has to be paid in the same way that we are.

MR. W. C. McCOLL, Walkerville: Our great trouble was in getting the contractor, or the man who is actually having the house moved, to pay. In the first place, there is a misunderstanding between the contractor and the owner. When he gets the order to have the work done, he does not figure, generally, on the cost of moving the wires. Our procedure now, is to have him come in and sign a definite order covering the work, the same as he would for any other work, so that we have no further trouble with either the contractor or the owner. We are operating in five municipalities. In one of those municipalities they have a by-law covering this; in the other four they have not. We make a standard practice of charging for time and material.

MR. J. G. ARCHIBALD, Woodstock: In Woodstock we have had for some years a by-law requiring that the Chairman of the Board of Works and the Superintendent of the lighting system sign the permit before any building can be moved. We had considerable trouble about the cost of moving the wires, so about a year ago the by-law was amended requiring that the owner pay the cost in connection with the moving of the building. On account of the permit having to be signed as it is, there is no trouble about the explanation of the costs. In every case we try to persuade the owner that the building is not worth the cost of moving, and very often we are successful.

MR. Aylmer: My idea would be to procure legislation to prevent the moving of buildings on streets where there are wires. In some cases it costs the municipality a lot of money, and sometimes it is absolutely impossible to get the wires back into place again as they were before. Some people say that you cannot stop them moving buildings, but anyone would have considerable trouble taking a building down the street in front of this hotel or down Yonge Street in Toronto.

THE PRESIDENT: You might get into trouble, and be charged with interfering with personal liberty if you tried to get such legislation. But it would be a very nice thing if it could be done.

MR. H. B. CHANT, Clinton: We had some difficulty about the moving of buildings, and I went to a Magistrate. He showed me that we had to clear the way.

* * *

"METHODS OF A.C. UNDERGROUND DISTRIBUTION TO OBVIATE NECESSITY OF TRANSFORMER INSTALLATIONS ON CITY STREETS."

MR. A. J. MAGLEY, Moloney Electric Co., Toronto: If we do not put transformers on poles, the only place left for them is in the lane in rear of the residences or if there is no lane you have to put them in the

ground.

There are two methods of putting them underground. One method is the regular subway compartment with a manhole. About two months ago it was suggested to us that we bury a transformer in the ground and put earth all around it. When it was first presented to us we were very dubious about it. I thought first of all that the soil would be a pretty good jacket to retain the heat and that the transformer would get very warm. However, we started out and made some tests.

We selected for the test three standard 25-cycle transformers, with 2,400 volts primary and 220 volts secondary.

The transformers were the type J, the regular pole type; and we made no changes to provide for keeping moisture out, excepting that the cover was on the level with the top of the soil; all of the transformer except the cover was exposed directly to the soil.

We started off with low loads and increased it daily, to see what the effect would be. The soil temperature was taken at some little distance from the transformer, so as not to be affected by the current, and rose gradually during the test from 13 to 18 degrees. That was taken about two feet down. That change was just the natural increase of the soil at this time of the year. I do not know how high it will get during the middle of the summer, for we have not yet tested that; it might go up as high as 30 degrees centigrade. These transformers were used as under ordinary load conditions.

The characteristics of the air-cooled transformer were such as you would expect, simply with peaks following the load. These peaks, for the transformers which were buried, followed about two hours after the load peak.

We had one transformer buried in a box of sand, 7 feet square by about four feet deep. We thought sand would be about the worst condition we could find in this kind of service. We supposed that a cool soil would conduct the heat better than sand or a sandy soil with its multitude of air pockets.

In general we find the temperature rise for the transformer buried in sand is not so rapid as that of the transformer in air; on the other hand, the cooling of the transformer in air was much more rapid than the cooling of the transformer in the sand. The buried transformers hold the temperature up pretty well, whereas the air-cooled transformer varied more. The buried transformer has about twice the temperature rise of the air-cooled transformer.

It followed from this experiment that we had to increase the size of the case to bring the temperature down to ordinary limits. We have not collected enough data as yet to tell how large we should make the case, but I think it would be about double. That would increase the total weight and also the amount of oil; but by increasing the amount of oil it increases your overload, giving it a greater peak

capacity at the same time.

It resolves itself into this, that it is a feasible proposition. We do not believe that the total cost will exceed 25 per cent., certainly not over 35 per cent. of that of an air-cooled transformer. To make it waterproof would not increase the cost very greatly. They would not be laid in a street but in a yard or boulevard. They cannot be damaged if a strong enough cover is used.

MR. C. E. SCHWENGER, Toronto: About the same time that Mr. Magley conducted these tests, we conducted similar tests in Toronto, with the idea of finding out at what load a transformer buried directly in the ground could be operated. The idea back of it all was to develop an inexpensive method of underground distribution, burying the transformers underground without going to the expense of building expensive subways and using subway transformers. Rough calculations show that if you consider a given kw. capacity on poles as 100 per cent., as the cost, if this direct burying scheme is successful, transformers could be installed at a cost of not more than 25 or 30 per cent. over that on poles. As against that is the regular subway construction which costs considerably over 200 per cent. of similar capacity installed on poles.

In Toronto we have a desire to beautify the residential section by keeping transformers and equipment of that kind off the streets. The consequence is that we put them on the business streets and at the present time the business streets are practically filled with transformers, and we now have to go into the residential streets with transformers; and this scheme has been thought of as a possible solution. As yet we have not secured sufficient data to say what the cost would be or what the possible operating difficulties would be, but we contemplate installing an experiment in buried transformers.

Our tests show that a transformer buried directly in the soil, operating against a similar transformer in the air, has an oil temperature not more than 14 degrees higher than that of the transformer in the air; and that the temperature of the oil in the transformer buried in the ground follows almost directly the air temperature, the same as it would if it were hung on a pole. Mr. Magley's tests also bear that out.

We find, in addition to that, that the temperature of the soil around the transformer, 36 inches from it, is practically at the air temperature all the time; that is the heat is being liberated in that 36 inches. On the whole, the scheme looks to be one well worth investigating and carrying to a conclusion.

We buried transformers in sand, in much the same way that Mr. Magley did. We carried on different tests of loading. We operated a transformer at 50 per cent. load continuously, with four hour periods of 125 per cent. load. That corresponds somewhat to the load on distribution transformers in regular service. You get those conditions of maximum temperature with the dry sand—about five feet

of it all around the transformer—rising only moderately.

MR. S. B. ILER, H.E.P.C. of Ont., Toronto: I would like to ask if you have worked out any scheme for leading the primary into the transformer.

MR. SCHWENGER: The method is open, especially in Toronto where we have a large number of small concrete poles. In that case we could put the 4,000 volt cable directly on a pole and run it down the nearest pole adjacent to the transformer installation, and put the cut-outs on the pole. We even had considered putting the temperature indicators on the pole as well, for ready inspection. Another feature which has been thought of is in connection with burned out transformers, is that if a transformer happens to burn out and has to be replaced, we would simply take off the cover, lift out the core and put a new one in. The leads running in would be provided with connectors. The job is practicaly a complete lead-covered job from the pole right down.

I might mention another possibility. In Toronto, on the one system, we have pillar boxes. Such a box could be used adjacent to the transformer for the housing of an oil fuse or some other high grade fuse which would be safe to operate.

MR. J. G. JACKSON, Chatham: I would like to inquire as to the position of such transformers in the paved areas. There the possibility that the distribution of heat would be very different, and also the moisture in the soil would be an important factor.

This suggestion of installing transformers underground is very interesting, but I think it would perhaps have a somewhat limited application. It might be useful in certain districts and under certain conditions; but if the cost would approximate one-third or more over the actual cost of overhead installation, it might reach the point of cost of a standard manhole. It would be at least as cheap and, I fancy, preferable to burying the transformer in the ground. It is quite possible to ventilate a manhole in a manner which will secure as great dissipation of heat as in a transformer exposed to the atmosphere.

We made some tests some years ago of temperatures in manholes and found that the temperature ran about 30 to 32 degrees, when the temperature outside was down to zero. It is quite possible to dissipate the heat from one or perhaps two 25 kv-a. transformers through the wall of a manhole without any special ventilation; but, as I say, the question of special provision for ventilation could be readily installed, and the fuses and protective equipment could be located in the manhole; whereas in this other case some provision would have to be made overhead for the other parts of the service.

MR. SCHWENGER: In connection with the possible temperature which might exist in a sidewalk, we have not put in an installation of that kind, but I do not think it would be any worse than the conditions under which we are testing now, namely those of thoroughly dry sand.

REPORTS

The Secretary's Report

The membership of the Association of Municipal Electrical Utilities again shows an increase according to the Utilities and Companies who have paid dues for the year 1924.

The total number of Member Utilities in 1923 was 133. For 1924, 20 Member Utilities have been added, while 6 who were members during 1923 have dropped out, making a net gain of 14 utilities, and bringing the total up to 147.

The new Member Utilities are Acton, Barton Township, Fergus, Goderich, Merritton, Otterville, Scarboro Township, Thedford, Coldwater, Dundalk, Holstein, Penetanguishene, Uxbridge, St. Thomas Rural Power District, London Rural Power District, Woodstock Rural Power District, Saltfleet Rural Power District, Beamsville Rural Power District, Niagara Rural Power District and Dorchester Rural Power District.

The utilities who were members during 1923 and did not renew for 1924 are Delaware, Lambeth, Palmerston, Rockwood, Winchester and Ripley.

The commercial members totalled 35 in 1923. Two of those companies have dropped out, while one that had been a member in 1922 came back and four new companies are added. This makes a net gain of three commercial members and makes 38 as the total for 1924. The new commercial members are The Coffield Washer Co. of Canada, Limited, Hamilton; Ferguson Pailin Limited, Toronto; Parkinsons (Canada) Limited, Toronto; and Winter-Joyner Company Limited, Toronto. It is in order that a resolution be passed electing the companies named to Commercial Membership in this Association.

Two names have been given me for election as Associates, viz., E. G. Maddock and D. G. Ferguson, it it also in order that a resolution be passed electing these.

The Association Membership lists show a total of 644 names, being distributed as follows:—

Class A.	207
Class B.	234
Commercial	137
Associates	66

All of which is respectfully submitted.

(Sgd.) S. R. A. Clement.
Secretary.

* * *

Minutes of the Convention

At 1 P.M. and prior to the opening session of the Convention, on Thursday, June 26th., the delegates met for the first Convention luncheon. At this luncheon, Major Alex. C. Lewis M.P.P., Secretary, Canadian Deep Waterways and Power Association, Toronto, gave an address on the commercial and international side of the proposed St. Lawrence River improvements.

The first session of the Convention was called to order by the President at 2.30 P.M., when he

gave a short address welcoming the delegates, and outlining the various questions to be taken up at the Convention. He also congratulated the various committees for their efforts in completing all arrangements.

Mr. G. F. Drewry, Assistant Engineer, H.E.P.C. of Ontario, Toronto, then presented his paper on "Analysis of Operating Costs in Hydro Systems". Discussion on this paper was by Messrs. H. C. Powell, V. S. McIntyre, E. I. Sifton and G. J. Mickler. Mr. V. S. McIntyre moved and Mr. E. I. Sifton seconded a vote of thanks to Mr. Drewry for his very able and instructive paper, which was carried unanimously.

Mr. F. W. Willcox, Ontario representative of the Society for Electrical Development, Inc., addressed the Association on the Better Home Lighting Campaign to be carried on during September, October and November of this year.

Mr. A. G. Hall, Chief Electrical Inspector, described the changes made in the rules for inside wiring as shown in the new rule book about to be issued.

Discussions on subjects outlined in the programme were started by Mr. R. H. Starr, as follows:—

"What methods are used for tree trimming"; discussion by Messrs. Wills Maclachlan, H. O. Fisk, S. B. Iler and W. K. Sanderson.

"What arrangements are made for guy anchors on private property"; discussion by Mr. H. O. Fisk.

"When poles are moved, who pays cost?"; discussion by Messrs. L. G. Evans, H. O. Fisk, R. Elliott, W. K. Sanderson, C. E. Schwenger and S. B. Iler.

"When houses are moved, who assumes cost of clearing lines"; discussion by Messrs. H. O. Fisk, C. E. Schwenger, A. O. Hunt, D. B. McColl, J. G. Archibald, and H. B. Chant.

The session adjourned at 5.30 P.M.

At 6.30 P.M. the delegates met for the Convention dinner, when they were addressed by Mr. W. S. Haney, M.P.P., Sarnia, which address was very much appreciated.

On Friday morning, June 27th., the session was called to order at 9.30 o'clock.

The Secretary presented his report covering membership for the year 1924. This report shows 20 new Utility Members while 6 have dropped out, making the total for 1924 as 147, that for 1923 being 133. Two Commercial Members have dropped out, while one that was a Member during former years but not in 1923 has come back and four new Commercial Members have come in, viz.: Ferguson Pailin Limited, Toronto; Parkinsons (Canada) Limited, Toronto; Winter-Joyner Co. Limited, Toronto and The Coffield Washer Co. of Canada, Limited, Hamilton. Two new names were presented for election as Associates, viz.: E. G. Maddock and D. G. Ferguson. The names on the Association lists

make a total of 644; 1923 showing 595.

It was moved by Mr. H. O. Fisk, Peterboro, and seconded by Mr. O. H. Scott, Belleville, That the names mentioned by the Secretary for Commercial Membership and Associates be elected. CARRIED.

The Secretary read a letter from the Commissioner of the Border Chamber of Commerce, Windsor, asking this Association to hold its Convention next summer at Windsor. It was moved by Mr. O. H. Scott, Belleville and seconded by Mr. C. T. Barnes, Oshawa: That the invitation to hold the next Summer Convention at Windsor be referred to the Winter Convention. CARRIED.

It was moved by Mr. J. G. Archibald, Woodstock, and seconded by Mr. O. H. Scott, Belleville; That Section 9, Clause A, of the By-laws be amended as follows:—

Delete the Schedule of Fees shown in this Clause.

Insert instead the following Schedule of Fees:

Less than	500 Consumers		—$2.00
501 to	1,000	"	— 5.00
1,001 "	2,500	"	—10.00
2,501 "	5,000	"	—15.00
5,001 "	10,000	"	—25.00
10,001 "	50,000	"	—35.00
Over	50,000	"	—50.00
Commercial Members			—10.00

CARRIED.

The question of affiliation with The Ontario Municipal Electrical Association that had been referred to the Executive Committee by the January Convention, was then taken up. The Secretary read a resolution carried by the Executive Committee recommending that the Association empower its Executive to join with the Executive of the Ontario Municipal Electrical Association in proceeding with such affiliation on the basis of a letter from Mr. T. J. Hannigan under date of February 2nd., 1924.

It was moved by Mr. J. G. Archibald, Woodstock, and seconded by Mr. R. H. Starr, Orillia: That the recommendation of the Executive Committee be adopted. CARRIED.

Mr. W. R. Catton, Brantford, Acting Chairman, Committee on Accident Prevention and Health Promotion reported on a handbook on Rules for Outside Construction that had been prepared by the Hydro-Electric Power Commission at the request of the Association and was now available for the Utilities, and moved its adoption. The motion being seconded by Mr. C. E. Schwenger, Toronto, was carried.

Mr. C. E. Schwenger, Distribution Engineer, Hydro-Electric System, Toronto, presented a paper on "Low Power Factor, Causes and Remedy". Discussion following this paper was by Messrs. J. A. Harris, W. S. Ewens, H. O. Fisk, E. M. Ashworth, M. J. McHenry, G. N. Brace, S. L. B. Lines, Jos. Showalter and C. W. Baker.

Upon a motion being duly made and seconded a resolution was passed extending to Mr. Schwenger the hearty thanks of the Association for his very excellent paper.

Mr. A. J. Magley, Moloney Electric Company, of Canada, Toronto.

opened a discussion on "Methods of a.c. underground distribution to obviate necessity of transformer installations on city streets." Others discussing this subject were Messrs. C. E. Schwenger, S. B. Iler and J. G. Jackson.

The session adjourned at 11.45 A.M.

At 12.30 P.M. the delegates met for the Convention luncheon when Mr. Geo. D. Leacock was the speaker. Mr. Leacock was in his best form and did not in any way disappoint his audience.

The afternoon session opened at 2.30 o'clock, when Mr. C. E. Schwenger, on behalf of Mr. F. F. Ambuhl, Assistant to the Chief Engineer, Hydro-Electric System, Toronto, presented a paper on "Induction Regulators — When are these necessary and where should they be installed?" Discussion following this paper was by Messrs. H. F. Shearer, O. V. Anderson and R. H. Starr.

It was moved by Mr. O. H. Scott, Belleville, and seconded by Mr. J. W. Peart, London: That a hearty vote of thanks be extended to Mr. Ambuhl for his paper and to Mr. Schwenger for presenting it. CARRIED.

The meeting was then thrown open for the discussion of subjects suggested by the delegates. Subjects taken up were as follows:—

"Difficulty from tree interference in changing from 2300 to 4000 volts."

"Holding joint Conventions with the C.E.A."

"The power of an electrical inspector to stop the sale of unapproved apparatus."

"Obtaining greater publicity regarding Conventions of the Association."

"Open circuits in series transformers used for street lighting."

"The use of radio in detecting leaky insulators."

During the discussions referred to above, the following resolutions were submitted.

Moved by Mr. E. G. Flowers, Toronto, and seconded by Mr. R. H. Starr, Orillia: That the Executive Committee consider extending an invitation to the Canadian Electrical Association, for its members to attend the Conventions of this Association.

CARRIED.

It was moved by Mr. R. H. Starr, Orillia, and seconded by Mr. R. H. Martindale, Sudbury: That the Executive Committee appoint a committee to see that the newspapers give the Conventions of this Association full publicity.

CARRIED.

It was moved by Mr. C. E. Schwenger, Toronto, and seconded by Mr. R. H. Starr, Orillia: That the Executive Committee appoint a committee to look after the entertainment of the ladies coming to the Conventions. CARRIED.

The President presented a resolution that had been passed by the Merchandising Section at its meeting that morning as follows: "That the booklet entitled 'Policy and General Rules for the Operation of a Hydro Shop' be recommended to the A.M.E.U. for use in Hydro

Shops in Ontario". It was moved by Mr. O. H. Scott, Belleville, and seconded by Mr. C. E. Schwenger: That the resolution in reference to the booklet entitled, "Policy and General Rules for the Operation of a Hydro Shop" be referred to the Executive Committee for action. CARRIED.

The session adjourned.

MERCHANDISING SECTION.

The Merchandising Section met at 9.30 a.m. for a round table conference when Mr. G. J. Mickler, Sales Dept., H.E.P.C., of Ontario, read a paper on "Merchandising Accounting". Discussion following this paper was by Messrs. D. J. McAuley, L. G. Evans, C. M. Pritchard, A. B. Scott, G. W. Blay, A. W. J. Stewart and P. T. Gaston.

It was moved by Mr. H. P. L. Hillman, Toronto, and seconded by Mr. A. B. Scott, Galt: That the booklet entitled "Policy and General Rules for the Operation of a Hydro Shop" be recommended to the A.M.E.U. for use in Hydro Shops in Ontario. CARRIED.

The session adjourned.

The afternoon session was called to order at 2.30 P.M. when Mr. C. M. Pritzker, Curtis Advertising Co., Windsor, Ontario, gave an address on "Advertising". Discussion following this address was by Messrs. A. B. Scott, G. J. Mickler and D. Geo. Clark.

It was moved by Mr. G. W. Blay, London, and seconded by Mr. J. B. Kelly, Goderich: That a hearty vote of thanks be extended to Mr. Pritzker and to Mr. Clark for the splendid talks they gave on advertising. CARRIED.

Mr. W. H. Childs then led a discussion on "Results of Giving Premiums to Stimulate Sale of Electrical Appliances." Others discussing this subject were Messrs. G. J. Mickler, G. W. Blay, R. E. Garrett, Hague, D. J. Phelan, A. M. Smith, Harry Bloom, C. T. Rutland, T. F. Moulton, D. B. McColl and T. F. Kelly.

Mr. G. J. Mickler presented a report from the Committee appointed at the January Convention to look into the matter of standardizing prices. The President having come in during the presentation of this report he was asked to say a few words. After a short address by the President the meeting adjourned.

On Saturday morning the delegates were the guests of the Hydro-Electric Power Commission of Ontario, on a visit to the Queenston Power House.

The register shows the total attendance at the Convention to have been 318 being classified as follows:—

Class A	120
Class B	38
Associates	39
Commercial Mem's.	89
Visitors	32

There were 208 at the Convention luncheon on Thursday, June 26th.; 262 at the Convention dinner and 282 at the Convention luncheon on Friday, June 27th.

The Papers and Discussions of the Merchandising Section will be published in the August Number

List of Electrical Material, Devices and Fittings

Approved by The Hydro-Electric Power Commission of Ontario in June 1924.

Appliances

WHITTAKER FIREPLACES, Windsor, Ont.

Fire Basket, Cat. No. 901.

* * *

THE CONTINENTAL ELECTRIC CO. LIMITED, 505 King St., E., Toronto, Ont.

"Royal" Washing Machine.

* * *

RENFREW ELECTRIC PRODUCTS LIMITED, Renfrew, Ont.

Portable Combination Table Stove and Grill, Cat. No. 410.

* * *

THE T. EATON CO. LTD., (Submittor), 190 Yonge St., Toronto, Ont.

RENFREW ELECTRIC PRODUCTS LIMITED, (Mfr.), Renfrew, Ont.

"Eaton Beauty" Upright Toaster, Toaster Stove.

* * *

CANADIAN GENERAL ELECTRIC COMPANY, LIMITED, (Submittor), King & Simcoe Sts., Toronto.

ELECTRIC VACUUM CO. INC., (Mfr.), Ivanhoe Rd., Cleveland, Ohio.

"Hotpoint" Vacuum Cleaner, Model 62.

* * *

*HURLEY MACHINE CO., (Mfr.), Circero, Ill.

HURLEY MACHINE COMPANY LTD., (Submittor), 66 Temperance St., Toronto.

"Thor" Ironing Machine.

Switches

THE DEVOE ELECTRIC SWITCH COMPANY, 414 Notre Dame St., W., Montreal, Que.

Enclosed Switch — Clock-operated, Type, A.

* * *

*MONITOR CONTROLLER CO., Baltimore, Md.

Automatic Switches—Magnetically-operated type. "Monitor Thermaload Starter".

* * *

*WESTINGHOUSE ELECTRIC & MFG. CO., (Mfr.), East Pittsburgh, Pa.

CANADIAN WESTINGHOUSE CO., LIMITED, (Submittor), Hamilton, Ont.

Automatic Switches, Types "Cam", "Mill", "Geared Limit", "Motor-operated".

Automatic Adjustable Thermostat.

* * *

Fittings

CANADIAN GENERAL ELECTRIC CO., LIMITED, 224 Wallace Ave., Toronto.

Medium Base Socket, Cat. No. C.G.E. 191.

* * *

SMITH & STONE LIMITED, Georgetown, Ont.

Cutout Bases, Cartridge Fuse, Cat. No. 1207A.

Cutout Bases, Plug Fuse, Cat. No. 1206.

* * *

*These devices are under the Underwriters' Laboratories re-examination or label service.

THE BULLETIN

Published by
HYDRO-ELECTRIC POWER COMMISSION
of Ontario

190 University Avenue
Toronto

Subscription Price $2.00
Per Year

CLOSING ADDRESS

by J. E. B. Phelps, Sarnia, President

GENTLEMEN, this is the first opportunity I have had of attending a meeting of your merchandising section. At the Convention in Toronto, as you know, I was presiding at the other session and did not have the opportunity to go in to your meetings. However, I understand that they were very successful. I have not got your report from your sessions at this Convention, but I can tell you, coming down from our own meeting, that you have a larger number in attendance here this afternoon than we had, so apparently your discussions here must have been very interesting.

I feel that this merchandising section is filling a great want in our Association. That refers specially to the towns that are operating Hydro Shops. A great many places have not yet seen the light and have not put in a Hydro Shop, but from the remarks that I have heard since I came into the room I think you are working along the right line.

The thought that you brought out about having a uniform price for various appliances in various municipalities is a good one. There should be no difference, and if there is a difference it should be due to the fact that possibly some Hydro Shops have lower operating costs than others. It may be that some Hydro Shops have a greater turn-over than others, and so on, and there may be different reasons why the prices are a little different, but it should not be possible for any person to move from one municipality to another and find that the prices are materially different. We should stick to our retail prices. We are entitled to a profit, we need it in our business, and we must do business on business principles.

I was interested in what discussion I did hear about the giving of premiums to stimulate the sale of electrical appliances. Mr. Garrett got into an argument there and, being Scotch, he took care of himself. He got the information he wanted to get, and that is very valuable to Sarnia Hydro. But the argument has been brought out that other businesses give some inducement to the people to buy and why

CONTENTS

Vol. XI. No. 8

AUGUST, 1924

Convention Number
Merchandising Section

should not we do the same. I think that is good business, and I think it is justified.

I will soon be out of the chair as your presiding officer, but I would like to see this Association carry on and give more leeway to this department. I would like to see possibly a day given to the merchandising section so that all of the delegates can attend and hear what you have to say in these sessions. If we could set aside one day I think it would be of far more interest. Possibly it would mean that we will have to extend our Convention another day, but it will be time well spent.

I do not know that I have anything more to say Mr. Mickler and gentlemen, but to congratulate the merchandising section on the success they have been making of their meetings at these two Conventions.

Hydro Shop Accounting

Every Hydro Shop in order to justify its establishment must conduct merchandising business along strictly business principles. One of the most important—yes—the most essential requirement of a modern business institution is an adequate accounting system properly designed to suit the particular business to which it is applied, to bring to light accurately the true operating condition of that business.

Electrical merchandising dealers, and Hydro Shops particularly, have been slow to realize that they are business institutions, and that the common rules of commerce apply to their operations. Recent developments, however, some political, others financial, have brought us to the full realization of the responsibilities devolving upon the management of a Hydro Shop, so as to avoid criticism, and a too oft repeated expression that Hydro Shop competition is unfair, and that electrical dealers find it financially impossible to remain in business in the face of such competition.

In designing an accounting system for a Hydro Shop, the principle functions of such a system must be considered, and plans laid accordingly. Briefly stated, these functions may be classified as follows:—

1. The accounting system must be designed so as to show the amount of money invested by the Utility to carry on the merchandising business. This is generally represented by the value of the inventory in saleable material and equipment, and in Accounts Receivable, reduced by the amount of surplus the business has accumulated.

2. To show the value of the inventory of saleable material, so that its proper relation to sales can be maintained. "Profits are made on turnovers, and lost on leftovers." Roughly speaking, a turnover from four to six times the inventory is essential to successful electrical merchandising.

3. To show the value of Accounts Receivable, so as to be able to judge the efficiency of existing collection methods, or of the plan adopted for time sales.

4. To show the cost of doing business in sufficient detail to permit of an intelligent analysis being made of the operations of the Shop, so as to be able to determine the relation between overhead expense and sales, also between overhead expense and the cost of merchandise. It is also desirable to be able to compare costs with those of other Shops operating under similar conditions.

5. To show the provision made in all sales to cover overhead expenses, and allow a sufficient margin of profit commensurate with the volume of business done. This margin of profit is necessary to provide for contingencies which may arise due to depreciation of inventories, bad debts, and business depression.

6. To provide an intelligent and detailed operating statement, which will reflect the true condition of the Shop's operations.

7. To provide a balance sheet complete and separate from that of the Utility generally, for further compari-

son, as may be necessary.

8. The system outlined in the following pages will perform all these functions if the rules laid down are properly and conscientiously applied, and an effort is made to bring out the facts as should be done.

On the broad assumption that each Hydro Shop is a Department of the Local Utility, separate and distinct from the parent body in every sense, except that the latter furnishes the capital to carry on the business of merchandising, we will consider the Utility Commission in the light of a bank for the Hydro Shop, and deal with it just as though it were a bank. This involves the charging through the general books of the Utility all direct expenditures incurred for the purchase of material and labor, and for operating expenses, also indirect charges of a general character resulting from the apportionment of general expenses on an arbitrary basis, or otherwise, to suit local conditions. These expenditures, and charges direct and indirect, will be considered as advances to the Hydro Shop, similar to advances made by the bank through the medium of a cheque, except that in this case the distribution vouchers of the Utility are the bank cheques, and these are used as the basis of the charges to the Hydro Shop Advance Account in the general Utility books, and they form the basis of credits to the Advance Account in the books of the Hydro Shop.

In a similar manner all collections for sales and otherwise for material sold and accounts paid, as well as rebates for merchandise returned to vendors, are credited to the Advance Account in the general books, and form the basis of debits to the Advance Account in the books of the Hydro Shop.

The balance shown in the account in the one case is a debit in the Utility books, and in the other case is a credit in the Hydro Shop books, representing the amount of money invested by the Utility in the merchandising business and automatically takes care of losses or profits which may have accumulated in the operation of the Shop.

Having established the relation between the Shop and the Utility generally, with regard to receipts and expenditures, if a Shop has been operating for some time without a separate accounting system, it is possible to separate the two Departments at any time providing the proper inventories of merchandise on hand and Accounts Receivable are taken. With value established for these, and with a possible knowledge of past profits, or deficits, the Utility's Advance Account with the Hydro Shop would be made up of the following:—

On the debit side there would be Inventory balance, Accounts Receivable balance, Office Equipment, Automobile Equipment, Deficits (if any), and on the credit side, Accumulated Profits (if any), and the net result of the above represents the capital investment at that particular time in the Hydro Shop. The Hydro Shop books would then have to be opened with the following style of balance sheet:—

Debits, Inventory of Material, Accounts Receivable, Office Equipment, Automobile Equipment, Deficits Accrued, Credits, Utility Advance Account, Profits Accrued. The Advance Account, credit balance, should agree with a similar debit balance in the

books of the Utility.

With a preliminary balance sheet in the ledger of a Hydro Shop, the opening of the other necessary accounts can be proceeded with.

A study of the merchandising situation over a broad field establishes the following as suitable and necessary accounts, and grouping of accounts, to permit of intelligent study being made of the affairs of a Hydro Shop.

REVENUE ACCOUNTS.

1. Overhead and Profit on Sales.
2. Cash Discounts on Purchases.
3. Miscellaneous Revenue.

I.—EXPENSE ACCOUNTS.

I.—Cost of Merchandise Sold.

(1) Material.
(2) Labor.
(3) Storeroom Salaries and Expenses.
(4) Freight and Express.
(5) Sales Tax.
(6) Electrical Inspection.

II.—Selling Expense.

(7) Sales Department Salaries and Commissions.
(8) Trucking Expense.
(9) Demonstrations.

III.—General Expense.

(10) General Salaries.
(11) Clerical Salaries.
(12) Printing and Postage.
(13) Telephone and Telegraph.
(14) Advertising.
(15) Appliance Repairs.
(16) Free service.
(17) Rent.
(18) Insurance and Taxes.
(19) Uncollectable Accounts.

IV.—Fixed Charges.

(20) Interest on Investment.
(21) Depreciation on Truck Equipment.
(22) Depreciation on Office Equipment.

Definition of Accounts.

REVENUE.

1. Overhead and Profit on Sales.

This account represents the difference between the actual cost of material, or labor, or repairs, or any combination of these three, and the selling price of an article, job or service. It is derived from the recapitulation of sales costs, which will be described further on.

The account will be credited each month with the total of the column in the Sales Journal bearing a similar heading. At the end of each month, against the total of this account, combined with the Cash Discount, and Miscellaneous Revenue Accounts, will be applied the various items of expenses called overhead, from which a balance will be obtained, which will determine whether a profit or loss has been made in the operation of the Shop during the period.

2. Cash Discount.

Credit this account with the total of the cash discount column in the Disbursement Journal.

In posting items to the Journal from disbursement vouchers, the amount of cash discount deducted from Vendors Account should be entered in this column in the Journal, and wherever possible, without seriously inconveniencing the finances of the Hydro Shop, cash discounts should be taken advantage of.

Debit this account also with the amount of cash discount, if any, allowed to consumers for cash payment of purchases. This may be derived from a special notation in the Sales

Journal, when sales are made and recapitulated.

3. Miscellaneous Revenue.

Credit this account with any miscellaneous earnings the Shop may have, such as receipts for scrap sold, rents received, rebates or commissions received from manufacturers, or others, as volume discounts, or for negotiating sales, which may be billed direct by the manufacturer, and any other items of revenue not otherwise classified.

COSTS.

I.—Cost of Material.

(1) Material—Charge into this account the total of the cost of material purchased, as given by the material column in the Distribution of Expenditure Journal, when the latter has been balanced up at the end of each month.

In making the distribution of invoices in the Journal, place in the material column only the bare invoice cost of the goods purchased, *not* including the Sales Tax charge, cash discount allowed, or the freight, express and cartage shown on invoices. These must, for the sake of simplicity in keeping stock records, be handled separately.

It is important that this rule be carefully and uniformly applied since it has a bearing on the proving up of the inventory, when comparing stock card totals, with the balance in the Material Account.

Simultaneously with the entry of invoices in the Disbursement Journal, the items purchased are carried to the stock cards, where also the bare cost of the material is used as the basis of reference.

The handling of these stock cards will be taken up further in this pamphlet later on.

The material account is also to be credited with the total cost of material sold, as indicated by the total of the material column in the Sales Journal, which represents recapitulation of the individual costs (equal to the stock record cost) of the material disposed of by individual sales.

The material account having been debited first with the cost of the inventory, then with the cost of material purchased, and this total reduced by the cost of goods sold, will show in the balance the true inventory value of the material on hand, and this balance should check very closely, almost to a cent, with the stock on hand, as shown on the stock cards.

2. Labor.

Charge into this account the total of the labor column in the Disbursement Journal, labor items representing wages paid on the hourly basis to employees, who render daily account of their time by time sheet, and all of whose time is sold on the hourly basis. This applies to wiremen, if a Wiring Department is being carried on. Where a wiring foreman is employed his wages or salary will not be charged to this account, but to Sales Department Salaries and Commission Account.

Charge into this account also the bills from contractors for installation charges complete on appliances afterwards billed to consumers at a price. Credit Labor Account with the cost of such charges when costing sales made at a price which includes installation.

In costing sales involving labor, the cost of such labor will appear on the costed slip, and if all labor purchased has been sold and accounted for, the

Labor Account should show a zero balance. Credit to the Labor Account the total cost of labor sold, as indicated by the total in the Sales Journal at the end of each month.

3. Storeroom Salaries and Expenses.

Charge to this account all stockkeepers' salaries and stockkeeping expenses, such as stock cards, maintenance of storeroom, packing material and labor, twine, paper and excelsior, also cost of repairing and renewing short-lifed tools and so forth.

4. Freight, Express and Cartage

Charge to this account all freight, express and cartage on incoming goods, also on goods returned to vendors, on which it may be necessary to prepay the carrying charges. The charge for delivery of goods to customers will not be charged to this account, but to Delivery Expense.

5. Sales Tax.

Charge into this account all Sales Tax, which appears as a separate item on vendors' invoices.

6. Electrical Inspection.

Charge to this account the fees paid for inspection of wiring jobs done by or for the Shop, and which fees are later considered as part of the cost of the sale.

II.—SELLING EXPENSES.

7. Sales Department Salaries and Commission.

Charge into this account salaries and commissions of salesmen, and clerks and others, including that of the Shop Manager, if actively engaged in selling merchandise. Charge into this account also the salary of the wiring foreman if one is employed.

8. Delivery Expense.

Charge into this account the salaries of delivery men, cartage charges for delivery, truck expense, if the Shop owns a truck, or borrows one from the Utility, and prepay freight charges incidental to the delivery of goods sold.

9. Demonstrations.

Charge into this account the cost of running special selling demonstrations, and the demonstration of appliances to new customers. This includes special window dressing expenses, the hire of demonstrators, and other expenses incidental to demonstrations of all kinds.

III.—GENERAL EXPENSE.

10. General Salaries.

Charge into this account such proportions of the salaries of the general officers of the Utility as may be deemed just, when considering the amount of time and attention devoted to the management of the Shop.

11. Clerical Salaries.

Charge into this account the salaries of clerks, other than salesmen and stockkeepers, as well as a portion of the salaries of the clerks of the Utility, such as cashiers, accountants and so forth, as may be determined by the value of the time and attention given to the keeping of stock records and so forth.

12. Printing and Postage.

Charge into this account the cost of all printing and postage expenditures.

13. Advertising.

Charge into this account the cost of all newspaper and periodical advertising, window dressing, exhibition, and similar displays, and all special advertising which may be done from time to time.

14. Telephone and Telegraph.

Charge into this account the cost of all telephone and telegraph expense

in connection with the running of the Shop.

15. Appliance Repairs.

Charge into this account the cost of repairs made by manufacturers and vendors, or others, where such cost cannot be taken up in the stock records.

This account will be credited through the Sales Journal, with the cost of repairs sold, and any balance in the account in the account in the ledger will represent the cost of repairs done free of charge to the customer.

16. Free Service.

Charge in this account, as far as possible, the cost of doing free service work. This will be possible, if, when such service is rendered, a sales slip is made out setting out the nature of the service, so as to permit of costing the same later. The total cost in labor and material entering into this free service will form the basis of the charge.

17. Rent.

Charge into this account monthly a portion of the carrying charges and maintenance of the building occupied by the Shop, if it is owned by the Utility, or such proportion of the rent paid as may be deemed just if a rented property is occupied. The amount or proportion charged is to be in keeping with the use made of the property by the Shop.

18. Insurance and Taxes.

Charge into this account all premiums for insurance of any nature carried to protect buildings, stock, equipment, or employees of the Hydro Shop, also all taxes, business or income, or otherwise, which may be charged to the Utility on account of the Shop.

19. Uncollectable Accounts.

Charge into this account monthly or annually such percentage of the Accounts Receivable as may be deemed uncollectable, and credit a similar amount to Uncollectable Accounts Reserve.

IV. Fixed Charges.

20. Interest.

Charge into this account monthly interest on the balance showing in the Utility Advance Account at a fair rate based on the prevailing rates for bank interest. Credit this account with interest received from consumers on time payments, if it is possible to separate it out.

21. Depreciation on Truck.

Write off 25% from the original value of the truck as an annual charge, and is it is desired to show a monthly increment for operating statement purposes one-twelfth of the annual charge can be taken out each month and credited to Truck Equipment Account.

22. Depreciation of Office Equipment.

Write off 10% from the original value of office equipment as an annual charge, dividing this into twelve monthly charges if desirable, and credit Office Equipment Account.

Instructions for Operating Accounting System.

To carry on the system of merchandise accounting in the most satisfac-

tory way certain forms must be used. Some of these forms being special have been made available through the Hydro-Electric Power Commission; others being commonly used, and easily obtained, are simply defined and recommended for use in the instructions which follow.

To open up a set of books for an existing Hydro Shop, the first thing necessary is that there be a reliable inventory of material and appliances on hand, properly priced, so that the carrying of the record of price and quantity in the stock records will give no trouble later. There must also be a reliable inventory of Accounts Receivable; also one of tools, and Utility equipment, and office eqiupment; all of these form the basis of the assets in the Hydro Shop balance sheet. Offset against these will appear the Advance Account balance, and the surplus, if any exists.

Given thus a true inventory, it is necessary to place the individual items on stock records.

Card records for keeping track of stock are most satisfactory from many points of view, and the form shown (Form 1) is well suited to the keeping of records of electrical merchandise.

From the inventory make out a card for each type and size of article recorded, showing as much detail as possible, and as provided in the columns of the card. Then properly place the quantity shown in stock on the particular date of the inventory, carrying details out to the Total Cost column. When the items on the inventory have been properly entered

STOCK CARD

RECEIPT OF MATERIAL							ON	WITHDRAWALS					
DATE IN	REFERENCE NO	BOUGHT FROM	QUANTITY IN	INVOICE PRICE	PER	TOTAL COST	ORDER	DATE OUT	SALE NO	QUANTITY OUT	TOTAL COST	BAL ON HAND	UNIT COST

ARTICLE	SIZE	DESCRIPTION	COST PRICE	RETAIL PRICE	MAX MIN	BIN NO.'S

Form 1.

CUSTOMER'S LEDGER CARD

NAME ACCOUNT No.

ADDRESS

DATE	ITEM	FOLIO	DEBITS	CREDITS	BALANCE

Form 2.

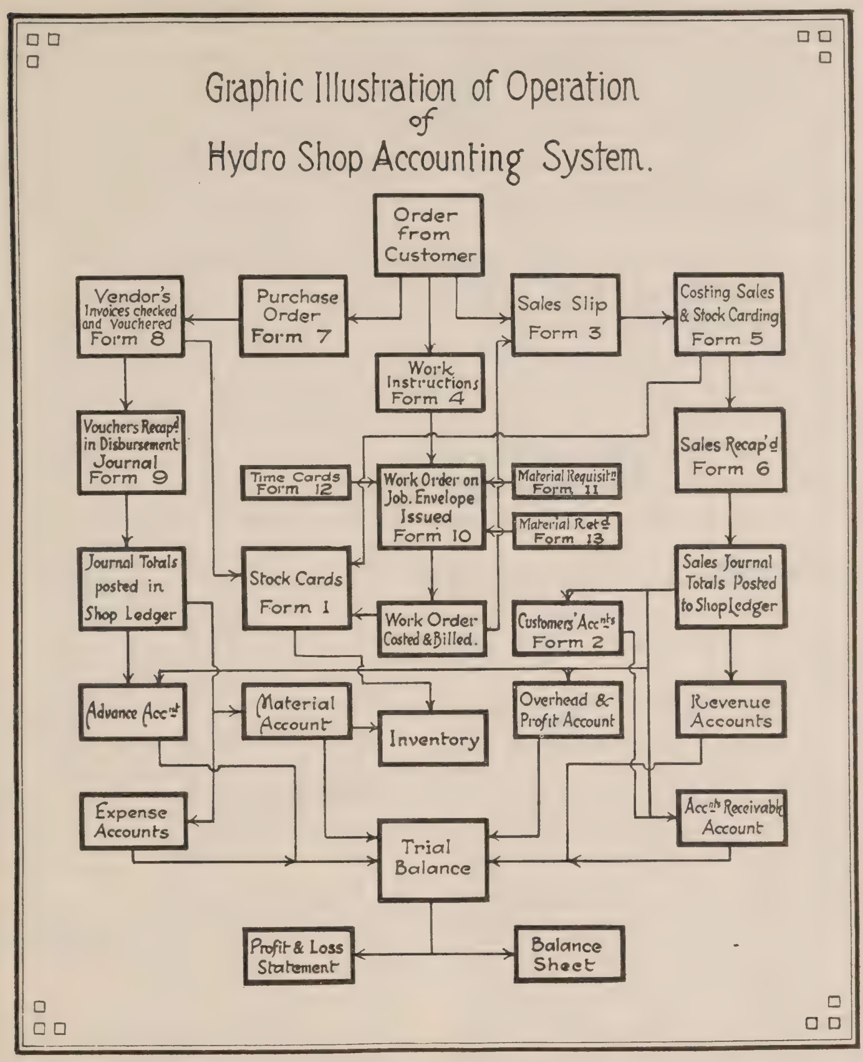
the summary of these total cost items should equal the total value of the inventory, and must do so otherwise trouble in balancing the inventory will follow sometime later.

From the inventory of Accounts Receivable open up a ledger account on cards or in loose-leaf ledgers, one per account, showing all the details possible. Form 2 is the most suitable form of record for keeping this type of account satisfactorily. Total of the balances carried to these accounts should equal the total of the inventory of Accounts Receivable, and must do so to avoid trouble later in balancing.

Inventories of tools, Utility equipment, and office equipment can be filed for ready reference, and for check at the end of the next inventory period.

With a clean sheet before us, we are ready to proceed with the records of a running Shop.

The diagram illustrated below is intended to show graphically how the various transactions involved in the purchase of material, and the sale of material, the payment of accounts, and the handling of various records, tie in with one another, and ultimately produce desirable results in the form of Profit and Loss statement, and Balance Sheet.



The first transaction when the Shop is opened is usually an order from a customer. If a customer comes in to purchase anything in stock, or something that can be put into stock, the verbal order from the customer is filled and a sales slip (Form 3) is made out, detailing the sale as fully as possible. If the order involves service of appliances, or represents charges for work to be performed, the instructions to do the work should be given to the proper party in the organization, on a form (Form 4) specially adapted for the purpose, and made out in duplicate or triplicate, as may be found necessary; two copies being given to the one to do

the work, or responsible for its performance—one of these to be returned upon completion of the instructions thereon, with the details of charge noted; the third copy will remain in the office as a record of instructions given. These instructions should be numbered serially.

The copy returned by service men will form the basis of entry on to a sales slip, which will serve as the bill to the customer in the regular way.

Sales slips (Form 3) are made in triplicate—one copy to the customer, one copy for the cashier, and one to be filed in numerical order of the serial order placed on the sales slip when printed.

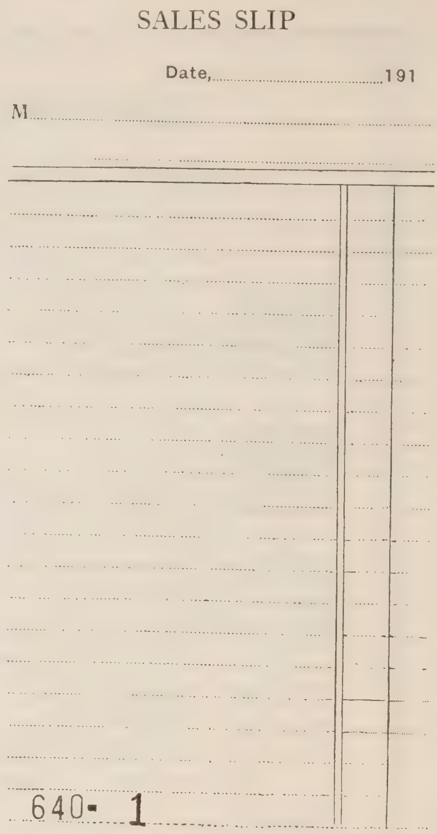
The triplicate copy is provided with a space, either by a rubber stamp, or permanent imprint, for costing sales (Form 5).

Sales slips should be used to record chronologically every transaction with customers, such as—

(a) Cash Sales.
(b) Charge Sales.
(c) Cash Refunds.
(d) Discounts, or Allowances.
(e) Credits for returned goods.
(f) Cash paid on Account.
(g) Free service (No charge).

If this plan is followed out by recapitulation of all sales slip particulars in the Sales Journal (Form 6) the complete history of each transaction is to be found in this one book, and can be easily traced.

Simultaneously with the order comes the necessity for ordering goods into stock. This should be done on separate order forms numbered consecutively, and for the exclusive use of the Shop (Form 7). This form


SALES SLIP

Date,.................................191

M.....................................

640- 1

Form 3.

should be in triplicate, one copy for the vendor, one copy for the storekeeper, and one for filing purposes.

Following the receipt of goods comes the vendor's invoice, which must be checked, verified, and passed on to the Utility for payment.

Besides invoices for material purchased, payrolls, invoices for overhead expenses, rent, interest, and other expenses incidental to the operation of the Shop, must be handled in a similar way, and passed on for payment, or for transfer into the Hydro Shop Advance Account in the general books of the Utility, where they are collected

No.____________

HYDRO SHOP

WORK INSTRUCTIONS

To______________________ Date______________192___

Please Perform Work as Indicated Below:—

Signed______________________ Signed______________________Manager

Form 4.

to form the basis of the charge to the Shop for monies advanced to do business. Usually this is done through the Disbursement Journal, which is provided with special columns for Hydro Shop charges.

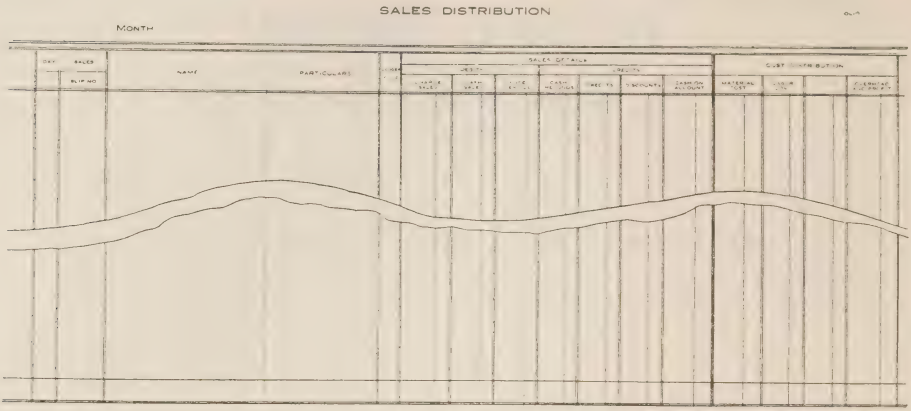
When the Utilities accounts have been entered in the Utility Disbursement Journal, the vouchers (which could be easily designed as per Form 8) containing items chargeable to the Shop, and from which these items are entered in the Shop column in the general Disbursement Journal, should be taken and entered in the Shop Disbursement Journal (Form 9). In entering these in the Shop Journal distribute the particulars noted on the voucher in the proper columns provided, namely, voucher number, date, name of vendor, total amount paid, and the distribution as called for into the proper columns.

COSTING SALES

Cost of Material..........	....	......
Cost of Labor..........	....	......
....	....	......
Overhead and Profit		
Total..........	....	......

Form 5.

At the end of the month, the total of the "Amount Paid" column should agree with the Shop column in the general Disbursement Journal, and the totals of the various columns, not including cash discount, should balance with this grand total, to which has been added the cash discount. The foot-

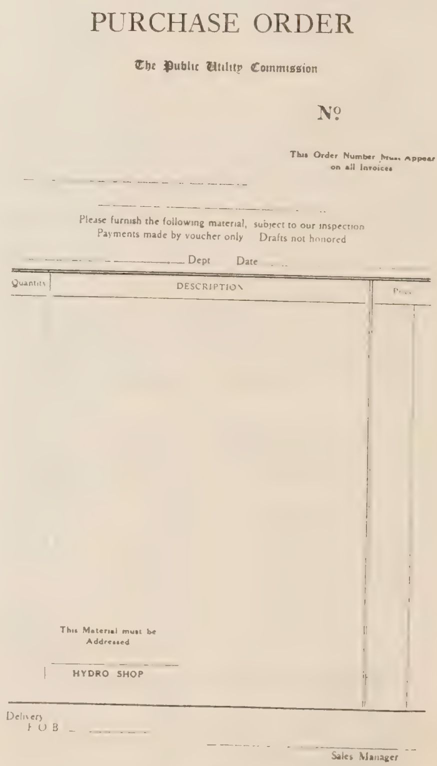


Form 6.

ings of the columns are then posted into their respective accounts in the Hydro Shop Ledger.

When the invoices for material coming into stock are checked against incoming goods and verified, the stock cards are entered up, that is the quantities, price and so forth, as called for on the cards, are filled in from the invoices, on all cards which may or may not have been provided for the particular goods invoiced. Every time new sizes or types of articles are received, new stock cards must be put into the files to accommodate the records of each size and type put into stock.

It is well to indicate in some way on invoices that the incoming material has been entered on stock cards. This can be done either by check mark or rubber stamp. This is important, since if every purchase of goods placed in the stockroom is not stock-carded, difficulties will follow in balancing the inventory at stock-taking time.



Form 7.

DISTRIBUTION VOUCHER

VOUCHER NO.........................

IN FAVOR OF

....

....

DATE 192

Merchandise Distribution

DEBIT

Material		
Labor		
Sales Tax		
Freight and Express		
Electrical Inspection		
Store & Sales, Sal. & Com.		
Printing and Postage		
Advertising		
General Salaries		
General Expenses		
TOTAL		

CREDIT

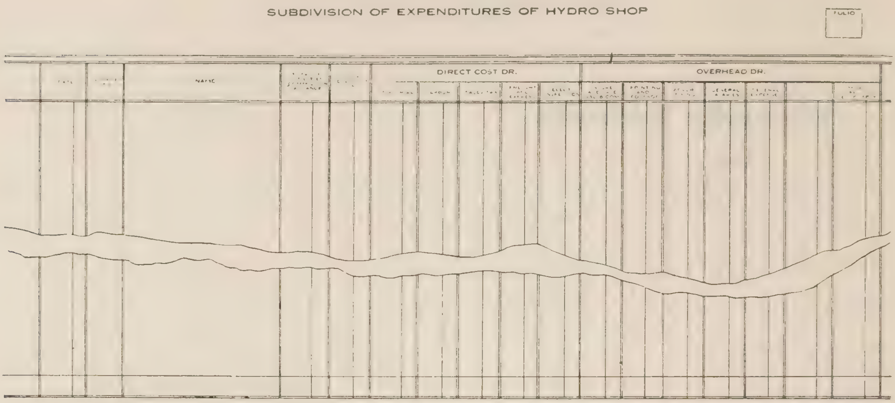
Cash Discount		
Amount Paid		
TOTAL		

GENERAL DISTRIBUTION

Form 8.

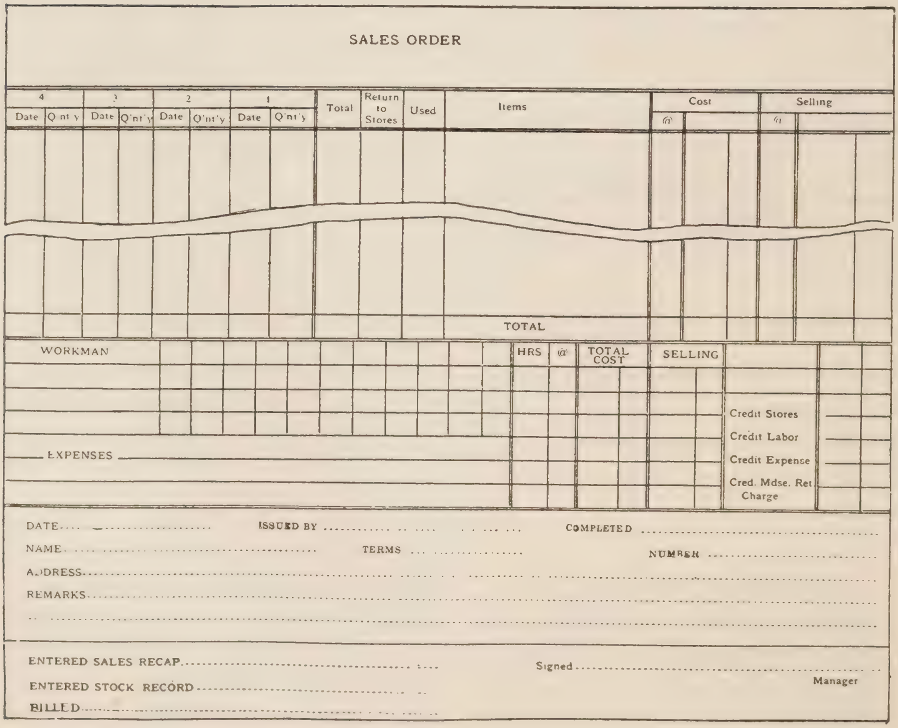
WIRING ACCOUNTS.

For Hydro Shops doing their own wiring or installation work special records are necessary to take care of the various operations which take place whenever wiring is engaged in by the Hydro Shop; these are in addition to those which take care of appliance sales, and for Shops engaging in this branch of the business these operations and the means of taking care of them by record will now be explained.



Form 9.

WORK ORDER



Form 10.

Requisition for Material

No. ________ *Date* ________

Charge to Job No. ________ *From Stock?* ________ *From Vendor?* ________

Roughing ________ *Finishing* ________ *Tools* ________

Name ________

Address ________

Quantity	Date Delivered	Material	Cost	

Remarks | *Total* ________

Rec'd by

Form 11.

When an order for installation or wiring work is received from a customer, it is to be recorded on Form 4, and at the same time a job envelope or some similar instrument opened up, and used as the means for gathering all the papers which will accumulate in connection with the job. It may be advisable to use Form 10 on a large envelope, or even use the form on a piece of paper, and attach to it all documents which might accumulate. The idea is to have all papers relating to each job together for reference at any time, and an envelope seems the most satisfactory way to perform this task.

As soon as the job is commenced and Form 10 issued to cover, material requisitions (Form 11) should be issued by the wiring foreman to the stockkeeper for material expected to be used on the job. As the work proceeds, time cards (Form 12) of the mechanics will come in daily, and the particulars should be entered in the spaces provided on the work order for this time. When the work is completed, there will be material returned not used, which should be recorded on a material return slip (Form 13) and sent in to the Storekeeper for record.

With the material requisition sheets, and the material returned sheets, it is possible to enter up the details of these on the work order form, to determine the quantities actually used. When a job is completed, the cost of material supplied is to be figured from the stock cards, entering the stock used on the job in the withdrawal columns of the cards, at the same time as the work is costed. The cost of labor and other items of expense in connection with the job are to be added, and the total cost to the Shop, for the various divisions of such cost determined. Other

Time Card

*Date*________________

I worked to-day as follows :	Job No.	Car Fare	Telephone	Rate	Hours

Signed

Form 12.

particulars, such as addition of profit and so forth, are to be entered, as well as the customer's price, when the work order is ready for billing to the customer.

If an invoice is necessary to show details a sales slip it is to be made out in the regular way, and the invoice attached to the original of the sales slip; these invoices should bear a series of numbers, which are to be placed on the work orders and sales slips for reference purposes.

As mentioned previously the most satisfactory way of handling transactions of all kinds for customers is to

Returned Material Record

*No.*________ *Date*________________

Credit to Job No. ____________

*Roughing*____________ *Finishing*____________ *Tools*____________

Name ________________________

Address ________________________

Quantity	Material	Cost	
Remarks		*Total*	
		Rec'd by	

Form 13.

record them chronologically on sales slips, to permit of the recapitulation of the details in the Sales Journal, which will serve as a reference book for all these transactions, and as a medium for posting to the Consumers' Ledger Accounts, and to the general Shop Ledger.

These transactions may be repeated as follows:—

(a) Cash Sales.
(b) Charge Sales.
(c) Cash Refunds.
(d) Discounts or Allowances.
(e) Credits for Returns.
(f) Cash paid on Account.
(g) Free Service.

At the end of each day the triplicate copies of sales slip are taken, and with the aid of the stock cards costed in the space provided by imprint or rubber stamp. Simultaneously with this operation, the other information called for by the imprinting is filled in, such as material cost, labor cost, repairs, profit and total. At the same time also the withdrawals from stock, if any, are marked off on the stock cards, and these latter are entered up, in all the detail necessary.

Where slips represent refunds, or credits for return of goods, the material is placed back into stock on the cards on the "In" side.

After this operation has been completed the sales slips are recapitulated in the Sales Journal, being recorded in numerical order, care being taken to account for all numbers of the series.

With cash sales, the number and particulars, will be filled in. The total of the sale falling into the cash sale column, and the cost of material, labor, repairs, and profit, will fall into their respective columns, as called for by the costed slip.

With charge sales, the number, name of purchaser, and particulars will be filled in, and the amounts distributed as called for on the slip. With cash refunds the same process will be followed as with cash sales, except that the amount of the refund will fall into the cash refund column. In distributing the particulars of the cost of the refund, the reverse of the process called for with cash sales will be followed; that is the entries in the cost distribution column will be made in red ink, to be deducted in the process of adding up the columns.

Discounts, allowances and credits will be recorded, giving number, name of the original purchaser, and the particulars of the total amount involved will fall into the proper column. The cost distribution will also be entered in red ink as with cash refunds.

Cash paid on account items will be recorded with the number, name of the payer, and the amount carried to the "Paid on Account" column.

Free service, or "No Charge" slips, will be handled by noting the number, name of the customer, particulars and the total cost of the bill. The latter being entered under "Free Service" column, and the distribution of this cost carried to the column affected by the transaction.

After the different entries have been made, and totalled in sub-total, the cash sale total, less the cash refunds, plus cash paid on account, should equal the amount taken in by the Utility Cashier, and credited to the Shop, as the day's receipts.

The next step is to post the charge sales, credits, discounts, and cash on account items to the Consumers' Ledger Account, indicating in the Journal the posting folios of these accounts.

At the end of the month the Sales Journal is balanced up as follows—the totals of the columns headed—

Charge Sales
Cash Sales
Free Service

will balance with the totals in columns headed—

Cash Refunds
Credits
Discounts
Material Cost
Labor Cost
Overhead and Profit.

It may be found convenient to deduct cash refunds from the cash sales total at the foot of the cash sales column; also to deduct credits and discounts from charge sales total, before posting all these totals as above.

When the book has been balanced for the month, the totals are posted into their respective accounts in the Shop Ledger.

It may be well perhaps to further explain the uses of some of the columns in the Sales Journal, to facilitate entering sales slips in the Journal.

Cash Refunds.

These are refunds for material returned to the Shop, and for which cash had at some previous time been paid. A refund may also be given for over charges or discount allowed, when such should have been attended to when the original cash sale was made.

Refunds of cash affecting original charge sales should be entered in red ink in Cash Paid on Account Column.

In costing slips for transactions of this kind, it must be borne in mind that when the original sale was made, the Material Account, Labor Account, and Overhead and Profit Account were credited as representing material going out of stock, or labor for which money was originally paid being sold, and profit being recorded on the transaction, the refund of the sale price, or making an allowance thereon, causes the reversal of all or part of the above operation, which can be recorded only by red ink entries.

By this process the material is automatically taken back into stock; the labor recharged to Labor Account, and the profit cancelled.

Credits.

These are allowances made for material or labor which are originally charged to the customer through charge sales. The same methods which would apply to cash refunds will apply to credits as well, that is in the matter of handling such transactions through the Sales Journal.

Discounts are allowances made on the purchase price of material or labor, which are charged originally to customers through charge sales; these discounts may be allowances for cash, or for commutation of original time sales, to which the time payment interest charge was added, when the sale was made. They may also be allowances to cover minor defects which are discovered after the customer has received the appliances bought for credit, or they may be other special dis-

counts or allowances not enumerated above.

In posting the totals of Sales Journal columns the following procedure will be followed:—

"Charge Sales" totals will be posted to the debit of Accounts Receivable Control Account.

"Cash Sales" totals, diminished by "Cash Refunds" will be posted to the debit of Utility Advance Account. "Credits and Discounts" totals will be posted to the credit of Accounts Receivable Control Account. "Cash on Account" totals will be posted to the debit of Utility Advance Account, and to the credit of Accounts Receivable Control Account.

Summing up the results of the operations for the first month of doing business, under the system outlined above, we have accomplished the following results, if the transactions of purchases and sales have been recorded as directed:—

We are able to produce a trial balance as follows:—

DEBITS.

Material (Inventory).
Accounts Receivable.
Delivery Equipment.
Office Equipment.
Labor.
Storeroom Salaries and Expenses.
Freight and Express.
Sales Tax.
Sales Salaries and Commission.
Delivery Expense.
Demonstrations
General Salaries.
Clerical Salaries.
Printing and Postage.
Telephone and Telegraph.
Advertising.
Appliance Repairs.
Free Service.
Rent.
Insurance and Taxes.
Uncollectable Accounts.
Interest.
Depreciation of Delivery Equipment.
Depreciation of Office Equipment.

CREDITS.

Utility Advance Account.
Overhead and Profit.
Cash Discount.
Miscellaneous Revenue.
Surplus.

Assuming that an original inventory of stock on hand existed at the outset, and that there was an inventory of Accounts Receivable also, along with one of Delivery Equipment and Office Equipment, we would have had a balance owing the Utility of the sum of all of these, as well as Debit Accounts of the amount of each in its respective place.

(1) By charging to the Utility Advance Account all charges and expenses incurred by the Utility on behalf of the Shop, and adding this to the original balance, then deducting the total of cash collections, we arrive at the new balance owing the Utility.

This balance represents the amount the Utility has invested in the Shop, and the amount on which monthly interest must be calculated.

(2) By adding to the inventory of material on hand, the purchases made during the month, and crediting the cost of the material sold, we arrive at the total value of the present inventory, which should equal the total

of individual totals on the stock cards.

(3) By adding to the Accounts Receivable balance, at the beginning of the month, the total of the charges for the month, and crediting the credits, discounts and cash paid on account, we arrive at the total value of the Accounts Receivable at the end of the month. This should agree with the total of the individual balances in the Customers' Ledger.

(4, 5 & 6) By opening up accounts for all the operating expenses incurred, and posting totals to the respective accounts, we arrive at a summary of expenses, to set against the summary of Revenue Accounts, which will show how the Shop is being operated, and after the Operating Accounts have been closed in the Revenue Account, through the Profit and Loss Account (7) we are able to produce a regular balance sheet, setting forth the assets and liabilities, and the profit or loss, as may have developed.

Thus all of the functions, which we expected the Merchandise Accounting System to perform for the Hydro Shop, as outlined in the beginning of this pamphlet, have been performed.

Discussion

MR. MICKLER: Up to date, there have been approximately fifteen towns in which either this System, or a System very similar to it, has been in operation. One or two of the towns have a System which is sufficiently in detail to provide the same results which this System does, although even in those towns they are lining up more closely with this System than formerly.

From the operating statements of eight Hydro Shops for 1923, I compiled the comparative statement which is shown below.

If you will examine the sheet before you, you will find that there are tabulated the sales and the total operating expenses, and there are shown the relation between the sales and the expenses. The expenses on the second line represent the total operating expenses as recorded in the books of the shop represented. In some of the shops they do not show their expenses in the same way as in others. For that reason, the items which are not common in all of the statements presented have been separated out.

The cost of putting merchandise into stock seemed to have been the item on which some of the towns differed. Some of them included the cost of handling merchandise into the cost of merchandise and others left that as a separate item, so all of those items of cost of putting merchandise into stock have been deducted and all reports reduced to a common basis.

You will notice in town No. 1 the total expenses are 15.2 per cent. of the sales.

In town No. 2 the total expenses are 19.5 per cent. of the sales.

In town No. 3, 18.1 per cent., or 11.9 per cent. with the cost of putting into stock deducted.

Town No. 4, the percentage is 15.7; town No. 5, 23.1 reduced to 21.3 per cent. with the cost of carrying stock

COMPARATIVE STATEMENTS OF OPERATION OF 8 HYDRO SHOPS - 1923

Municipality Number	1	% of Sales	2	% of Sales	3	% of Sales	4	% of Sales
Total Sales	$141,531.77		$200,207.77		$14,205.84		$51,151.05	
Total Expenses	21,435.72	15.2	39,040.08	19.5	2,575.14	18.1 x(11.9)	8,036.05	15.7
Gross Profit	29,501.62	20.8	41,533.36	20.7	3,681.93	25.9	8,972.29	17.6
Cost of Putting Mdse. into Stock	£		£		879.36		£	
Balance of Profits	29,501.62		41,533.36		2,802,57		8,972.29	
EXPENSES								
Delivery Expense			1,400.00	.7			538.75	1.1
Salaries and Com. Labor	6,973.01	4.9	18,357.62	9.1	750.00	5.3	3,262.50	6.1
Advertising	2,910.33	2.2	5,204.69	2.6	44.50	.3	1,500.00	3.0
Rent	7,650.00	5.4	3,000.00	1.5	500.00	3.5	2,234.00	4.5
Insurance and Taxes	58.79							
Interest	2,978.76	2.2	6,245.60	3.2	121.64	.8		
General Expenses	743.56	.5	4,019.86	2.0	279.64	2.0	500.80	1.0
Inspection Fees								
Bad Debts			812.31	.4				
Total Expenses	21,435.72	15.2	39,040.08	19.5	1,695.78	11.9	8,036.05	15.7
Net Profits	8,065.90	5.6	2,493.28	1.2	1,106.79	7.8	936.24	1.9
INVESTMENTS								
Inventories	15,547.51	11.0	45,915.26	22.5	2,272.91	16.0	7,012.92	14.0
Accounts Receivable	56,119.41		59,753.80		5,204.69		4,500.00	
Totals	71,666.92		105,669.06		7,477.60		11,512.92	

X Percentage with Freight, etc. eliminated. £ Freight, Express, Sales Tax and handling added to cost of material before figuring Gross Profits.

COMPARATIVE STATEMENTS OF OPERATION OF 8 HYDRO SHOPS - 1923

Municipality Number	5	% of Sales	6	% of Sales	7	% of Sales	8	% of Sales
Total Sales	$35,696.04		$110,342.24		$17,740.01		$264,038.58	
Total Expenses	8,249.99	23.1 x(21.3)	27,608.45	25.0 x(21.4)	3,065.30	17.3 x(12.1)	41,141.95	15.5
Gross Profit	9,297.03	26.1	31,388.31	28.4	3,550.04	20.00	50,451.98	19.1
Cost of Putting Mdse. into Stock	644.44		4,071.94		926.32		£	
Balance of Profits	8,652.59		27,315.37		2,623.72		50,451.98	
EXPENSES								
Delivery Expense			752.16	.7	176.63	1.0	1,958.53	.7
Salaries and Com. Labor	4,899.55	13.8	11,788.05	10.8	732.58	4.2	21,023.83	8.1
Advertising	501.20	1.4	2,386.41	2.1	101.40	.6	2,587.80	.9
Rent	1,400.00	3.9	2,580.00	2.3	325.00	1.7	3,000.00	1.1
Insurance and Taxes	151.47	.4	851.73	.8			937.15	.4
Interest	576.00	1.6	3,474.49	3.2	414.45	2.4	6,704.16	2.6
General Expenses	77.33	.2	1,244.16	1.1	358.14	2.0	4.639.73	1.8
Inspection Fees			459.51	.4	30.80	.2		
Bad Debts							290.75	.1
Total Expenses	7,605.55	21.3	23,536.51	21.4	2,138.98	12.1	41,141.95	15.5
Net Profits	1,047.04	3.0	3,778.86	3.4	484.74	2.7	9,310.03	3.6
INVESTMENTS								
Inventories	8,561.54	24.0	14,896.21	13.0	3,614.09	20.5	40,660.23	16.0
Accounts Receivable	15,085.27		54,022.31		4,137.96		88,815.84	
Totals	23,646.81		68,918.52		7,752.05		129,476.07	

X Percentage with Freight, etc. eliminated. £ Freight, Express, Sales Tax and handling added to cost of material before figuring Gross Profits.

deducted.

In town No. 6 it is 25.0 per cent. reduced to 21.4 per cent. with these charges deducted.

In town No. 7 it is 17.3 per cent. or 12.1 per cent. with these charges deducted, and in town No. 8, 15.5 per cent.

This would indicate that, generally, the overhead expenses of these eight Hydro Shops vary from 11.9 per cent. to 21.4 per cent. The gross profits vary from 17.6 per cent. to 28.4 per cent. Of course, the sales, in some of these municipalities, do not compare favourably with the sales in others, for the reason that where wiring is done in some municipalities, that is, the installation of ranges and water heaters, it is done on the flat basis. Where this flat basis is the same as the municipality pays for the installation to a contractor or its own men there will be no profit recorded on the sales. Windsor, for instance, sells its wiring at what it costs, and with those items included in the total of the sales the relation between overhead expenses and sales will be lower, and the profit will be correspondingly lower. As a matter of fact, they should have been deducted, but in order to impress on those municipalities the need for profit on such transactions these sales were left in, as I think they ought to realize a profit on all transactions no matter what they are, whether it is the sale of labour, or the sale of material, or the sale of service, it should all be rendered at a profit.

You will notice that the expenses have been similarly compared. I tried from the statements presented to equalize these expenses as nearly as I could, that is, to set opposite each item of expense a corresponding item from each statement. Some of them, of course, called similar items by different names, and it was not easy to identify what the expenses were, but that was because they had not standardized their method of distributing accounts. We hope that by next year we will have that all remedied. However, in general, they are approximately the same.

Five out of the eight towns had a delivery expense account by itself, and from this you will see that the delivery varies from .7 per cent. to 1.1 per cent. Of course, I believe even in some of these, they have delivery to the consumer and delivery from the freight sheds combined, while others may not, so that this is not really a true comparison of their delivery expense.

Salaries, Commissions and Labour. Town No. 1 the salaries and commission represent 4.9 of their sales. Town No. 2, 9 per cent.; town No. 3, 5.3 per cent.; town No. 4, 6 per cent.; town No. 5, 13.9 per cent.; town No. 6, 10.7 per cent.; town No. 7, 4.2 per cent. Town No. 8, 8 per cent., a variation all the way from 4.2 to 13.9, which shows that some towns have to pay more to sell their goods than others.

Advertising, town No. 1, 2.2 per cent.; town No. 2, 2.6 per cent.; town No. 3, .3 per cent.; town No. 4, 3 per cent.; town No. 5, 1.4 per cent.; town No. 6, 2.1 per cent.; town No. 7, .6 per cent. and town No. 8, .9 per cent.

Rent, 5.4 per cent.; 1.5 per cent.; 3.5 per cent.; 4.5 per cent.; 3.9 per cent.; 2.3 per cent. and 1.7 per cent.

Interest 2 per cent.; 3.2 per cent.; .8 per cent.; 1.6 per cent.; 3.2 per cent.; 2.4 per cent. and 2.6 per cent.

General Expenses, .5 per cent.; 2.0 per cent.; 2.0 per cent.; 1 per cent.; .2 per cent.; 1.1 per cent.; 2.0 per cent. and 1.8 per cent. That General Expense item is another one of these indeterminate items. Some towns called general expenses one thing and others called it another thing, but, generally, the items compare favourably with one another. There may be one or two instances where they do not correspond.

Net Profits, 5.6 per cent.; 1.2 per cent.; 7.8 per cent.; 1.9 per cent.; 3.0 per cent.; 3.4 per cent.; 2.7 per cent. and 3.6 per cent.

You can see that the majority of these towns, in fact all of them, are operating on a pretty slim margin. Take, for instance, Town No. 2, 1.2 per cent., that is approximately equal to the cash discount on the purchase of material. If they did not take their cash discount they would not have any profit. Town No. 4 is the same, and Town No. 7 is the same. It shows you how important it is that cash discount be taken wherever possible to avoid the possibility of losing the slim margin of profit under which operations are carried on.

Below, we show the relation between the investments, that is, the value of the Inventories and Accounts Receivable. From this we can get a general idea of the turn-over. I was not able to get the cost of material purchased as compared with the inventory, because none of the municipalities showed how much material was bought, so the actual turn-over in ratio could not be determined, but it can be figured out approximately from the approximate profit each has.

Town No. 1 has an inventory of over $15,000, which represents 11.0 per cent. of the sales.

Town No. 2 has an inventory of $45,915, representing 22.5 per cent. of the sales.

Town No. 3 has an inventory of $2,272, representing 16 per cent. of the sales.

Town No. 4 has an inventory of $7,000, representing 14 per cent. of the sales.

Town No. 5 has an inventory of $8,561, representing 24 per cent. of the sales.

Town No. 6 has an inventory of $14,896, representing 13 per cent. of the sales.

Town No. 7 has an inventory of $3,600, representing 20.5 per cent. of the sales.

Town No. 8 has an inventory of $40,660, representing 16.0 per cent. of the sales.

You will notice that Town No. 1 did $141,000 of business on a $15,000 inventory. Town No. 2 with three times the value of the inventory of Town No. 1 had only about 30 per cent. more business. Town No. 5 had $8,500 in stock to do $35,000 worth of business. Town No. 6 had an inventory of $14,896 to do $110,000 worth of business. It shows that the shop which purchases properly can sell a lot of goods without having a great quantity of goods in stock. It is not necessary to buy a lot of material in order to do business now-a-days, because most manufacturers carry enough in stock to supply a reasonable

demand within a reasonable time. Some people have an idea that the minute they start doing business they have to build a cellar and fill it full of stock, and when they come to figure up three or four years afterwards where their money has gone they generally find it in the basement and, as a rule, it is in obsolete material, and the theoretical profits made during three or four years disappear very rapidly.

The Accounts Receivable vary, of course, depending on the conditions in the municipalities shown. Some towns have a very elaborate time payment system, others have not any, Ottawa, for instance.

The Total Investment of Town No. 1, is $71,000. Town No. 2, $105,000; Town No. 3, $7,500, and so on.

You will see by these figures that the importance of Hydro Shops in some municipalities is attaining considerable proportions, that is, considerable enough to make them rank in very close relation to the power and lighting business of the municipality. I venture to say that with some of these towns showing from $141,000 up to $264,000 worth of sales these will compare very favourably in volume with the revenue from the sale of light and power, and the importance of having records that will show in detail the operations of those shops cannot be stressed too much.

As I said before, we hope to get all towns in line, especially those that are not exactly in line so far as distribution of accounts is concerned. We would like to have them all uniform before the end of this year, so that their statements will, perhaps, be a little more comparative. We expect to have a lot more who are not on this statement so that eventually statements of this kind, and more elaborate statements, will appear as part of the Commission's Annual Report showing the operations of every Hydro Municipality operating Merchandise Departments, whether it shows a profit or a loss, and it behooves everyone who is at all interested in merchandising to see that this is done in a way that it will not show unfavourably in these reports which are published.

MR. D. J. McAULAY, H.E.P.C. of Ont.: In that report you have there, is the wiring and sale of appliances combined, or just the sale of appliances?

MR. MICKLER: Anything that is billed to consumers for which they collect cash is in their sales, it is the total amount of business done, so far as I am able to learn. Of course, some of them (one of them particularly) did not tell me what all was included, Town No. 2, for instance.

MR. McAULAY: That is the one I had reference to. I know they do wiring and do electrical inspection, and I do not see Electrical Inspection charged.

MR. MICKLER: Town No. 2 simply gave the total value of the sales. I do not think they have the wiring in there at all. When we are able to get around to these towns and see that they are doing things uniformly we will then be able to keep those things more closely in line.

MR. L. G. EVANS, Toronto: When the work is done by contract, do you recommend that there should be no profit, or do you recommend

that we take a profit on the contract?

MR. MICKLER: If you make a contract with a wiring man to install ranges, or water heaters, or any other electric appliance, I would recommend that you, in billing your consumers, take a profit to yourself. You can, in most cases, make a better bargain with the wiring contractor on a great number of jobs than an individual consumer can, and you are entitled to enough profit on those transactions to cover your expense of handling them. If you do not take a profit on wiring you will have to add a little more profit to your appliances, because you can see from this statement that there is nothing to spare, even where they are not doing any wiring. Take Town No. 1, they are not doing any wiring, they only made 5 per cent. profit.

Town No. 4 is not doing any wiring, and it made 1.9 per cent. profit. So you cannot perform any functions for your consumers without considering that some of your overhead has to be provided for.

I noticed in an American magazine here recently a comparison between the sale of different types of appliances in a great many cities in the United States. They had these tables prepared and grouped according to the size of the municipalities, and there were about ten different groups ranging from 50,000 population, up to cities with a population of a million or more, and in reading that article over and looking at the tables I thought it would be interesting to show a similar comparison of sales of appliances in Hydro Municipalities. The most noticeable feature of the tables presented in the magazine was the absence of any figures on ranges.

Graphs showing the relation between the sales of the different types of appliances were presented. Washing machines took up about half, vacuum cleaners a third, and the rest distributed among ranges, toasters, and what not, but ranges were negligible.

In the report circulated among you, you will find that in practically every municipality the range is the most important appliance sold. Take London, for instance. London sold over two and a half times as many ranges as they did washing machines; Windsor pretty nearly five times as many ranges as washing machines, and Stratford three times as many ranges as washing machines.

I do not know whether there is very much value in this statement, but I thought it would be interesting to show you what the comparison is in the different municipalities. Some towns say they cannot sell washing machines, other towns say they cannot sell ranges. It might be well to compare your town with another of approximately the same size operating under similar conditions and see what methods are being employed which make their figures so much different from yours.

MR. I. PRITCHARD, Chatham: With regard to costing sales, what, in your opinion, is the proper way to cost the sales? Should you add to the cost of the material the sales tax and laying-down charges, or should you cost the sales on the bare cost of the material? There is some difference of opinion regarding this.

MR. MICKLER: Of course, the

APPLIANCE SALES—1923

Table showing relative sales of larger electrical appliances in 21 Hydro Shops during 1923.

This table indicates the purchasing tendencies of the people of these Municipalities—the relative proportions of sales effort being put behind these appliances, and the sales possibilities for future efforts.

	Ranges	Washers	Vacuum Cleaners	Water Heaters	Air Heaters and Grates	Irons
Brighton	2	0	3	2	5	12
Belleville	38	37	42	22	36	92
Chatham	40	23	22	15	26	74
Dundas	12	2	3	0	16	10
Guelph	101	30	15	38	138	263
Hamilton	476	272	232	90	204	319
Kingston	13	4	6	6	45	93
Kitchener	49	10	12	5	50	44
Lindsay	6	1	1	5	15	61
London	596	266	332	65	265	334
Niagara Falls	68	11	3	6	30	14
Ottawa	246	0	0	97	93	210
Paris	17	10	0	1	1	2
Perth	24	0	8	1	11	56
Stratford	401	133	60	64	178	93
Sarnia	103	81	75	13	7	99
Trenton	4	7	10	0	3	25
Toronto	1561	376	824	319	858	5260
Welland	48	4	26	13	15	19
Windsor	1043	224	324	167	283	366
Woodstock	130	8	4	23	55	36

question of sales tax is almost negligible now, because the sales tax forms part of the cost of the material, it does not appear on invoices any more, but I have found that the fewer items you have to consider in the cost of material sold the less complicated is going to be your record, and the easier it is going to be to make up your stock cards, particularly with the recording of invoices involving more than two or three items especially where wiring material is purchased. As invoices cover sometimes one, or two or three pages, the distribution of freight, cash discount, and handling charges, is a very cumbersome duty and, in order to eliminate that, the cost of the material which should be carried to the stock cards is represented by the bare cost as shown on the invoice, excluding cash discount, etc. Of course, there are some times when that rule can be waived to a certain extent. If you only buy an item once, the freight is prepaid, or the freight is shown on the invoice charged to you, you can use your own judgment and include as cost, the total invoice price.

If you will study the Operating Expenses, the way they have been grouped, you will see that you can get the same result in the end without all the trouble of making a sub-division of freight, etc. every time on an invoice. You will notice we show the cost of merchandise sold. That is the cost of material, and the cost of labour handling the material, store-room salaries and expenses, freight and express, and sales tax. If one wants to put all this into his cost of material why, he will have the whole thing in one operation. The method of treatment recommended is to group these different expenses and add them to the bare cost of material. It is much simpler in operating the stock system to exclude cash discount, and freight and expenses of handling. I am not saying, mind you, that it is not part of the cost of material, it is, but so long as we know how these items have been handled, we can be satisfied with the result.

There is another thing, of course, the question of duty on imported material. I did not mention duty in this paper, because I did not come across any case where duty was actually paid until after the paper was prepared. At any rate, the question of duty must be taken care of in the case of material purchased abroad. You will have to add in the duty to the cost of material otherwise you will be liable to sell goods for less than cost.

Attention has been drawn to the fact that very few of these towns show any provision for bad debts, or any loss on account of bad debts. The question of bad debts is not a very serious one in Hydro municipalities. Legislation provides almost an airtight means of securing money from consumers, except from one who dies, and if even he has signed a lien note for an appliance, you can get the machine back. I do not know of many Hydro municipalities where they have lost very much on bad debts. What has been your experience, Mr. Scott?

MR. A. B. SCOTT, Galt: We have had some loss, principally on wiring jobs, where we have not had a lien. That is practically the only case.

MR. MICKLER: How would that show up in your accounts?

MR. SCOTT: We opened up a reserve account for bad debts, but up to the present time we have not placed any accounts into that, but we will have to do so this year.

MR. MICKLER: What is your experience, Mr. Blay?

MR. G. W. BLAY, London: I think this report shows that we had $812 last year.

MR. MICKLER: That provision is made every year?

MR. BLAY: Every year. We are unlike other municipalities, they do not appear to have any.

There is one point I would like to bring up, that is, the lien note. We find that in these times a great many people are moving from one city to the other, and, invariably, they take appliances with them although they are not paid for, and, in many cases, we have no record of their leaving town. They get out overnight and take your washing machine, or whatever it is, with them, and we have found that the lien note does not apply to an appliance moved into some other municipality, it is not worth the paper it is written on.

A MEMBER: Does it not apply where the lien note is registered?

MR. BLAY: No, not if they get the appliance out of the city.

MR. McAULAY: You can seize the article as long as it remains in the Province, I have seen it done.

MR. BLAY: The party did not offer any resistance, possibly.

MR. McAULAY: Oh yes they did. As long as there is a number on the machine, or a distinguishing mark, the Act gives you permission to recover. As I say, I saw it worked out in one case.

MR. BLAY: We tried it in Stratford and we lost out.

MR. MICKLER: That is a case for co-operation between Hydro Shop men.

MR. McAULAY: We have a case at the present time where a man moved to Stratford and took a washing machine with him. We finally located the machine and requested the Hydro at Stratford to pick up the appliance and have it crated.

MR. MICKLER: Did you get your appliance back?

MR. McAULAY: Not yet, but we will get it. Another case is where a lady purchased a washing machine from the Walkerville Hydro. She did not have it paid for and moved to London. They wrote us and asked us if we would not take the account off their hands, so we purchased this account from them, of course, at a reduction. She made two payments on the machine and skipped back to Walkerville.

MR. MICKLER: Can't you sell it back to Walkerville?

MR. McAULAY: Well, the management of the shop there has changed, and the Manager claims he does not know anything about it, but there are a lot of uncollectable accounts just the same.

MR. MICKLER: One thing about it is that London apparently acknowledges they cannot collect accounts and others do not want to admit it.

MR. A. W. J. STEWART, Toronto: I think Mr. Mickler is to be congratulated on the amount of detail brought out in connection with his paper, and I am sure he must feel grati-

fied with the large attendance here this morning considering the fact that there is another meeting running concurrently with this.

One point brought out in connection with wiring on a lien note. In Toronto we have our hire-purchase agreement established in such a way that the charge for the wiring, the cost of the wiring, becomes a charge against the property. If a tenant buys a range on time where we do the installing he has to pay the total cost of the wiring plus the ordinary initial payment on the range, so that if he moves we are sure of the wiring anyway. The only exception is where he gets the owner of the house to sign the time purchase agreement with him, so that we can always collect for the wiring. In the case of moving out of town, we have found that we can pick up those goods, if we can find them. Nearly always we have been able to trace them. We had a case not long ago of a customer who lived outside the city limits, and we had a good deal of trouble trying to pick up an appliance. The customer would not let us into the house, and finally we went out with a truck and collector and the Sheriff, and one or two others, and found that the night before the man had moved into a different municipality. In order to seize there we had to go back to the Court and get it transferred to the jurisdiction of a different Sheriff, and the previous order of the Court held so that we could pick up the appliance. In another case, we got the appliance because the man saw that he was chased so that he came to the conclusion there was no use trying any further to keep it.

On page 300 here there is a list of transactions that are covered by Sales Slip. That agrees pretty much with our method, except that we never make a sales slip unless it shows a debit, that is, if a customer brings back an appliance we have a separate form for it, and it goes to the accounting department the same as a Sales Slip would and is credited to the customer's account. In case a customer brings back an article for exchange and takes something of greater value, we give him credit for the other, but that is pretty much all a detail.

MR. MICKLER: Of course, when I designed this system I did not expect that it would be universally applicable to all Hydro Municipalities. There are some in which, perhaps, the details will be a little too many, and others in which they are not enough. In general, though, the principle is applicable to all Hydro Municipalities. The actual details of operation are left, to a very great extent to the Municipalities themselves, and the forms shown here are not necessarily the forms that have to be used, they are simply suggested forms. I know that in one or two of these forms they have already been changed.

I might say that the Hydro are keeping in stock Form No. 1, Form No. 2, Form No. 3, Form No. 9, and Form No. 11, in a revised form, Form No. 12, in a revised form, and Form No. 6. Those forms can be obtained from the Hydro at cost.

A MEMBER: The question was asked how you get the record of goods received into stock on the stock

cards, whether it is from the invoice, or from a receiving slip.

MR. MICKLER: Well, in the majority of cases, they have not a receiving slip. The invoice is passed from the office to the Stores Clerk and he counts the material and advises in the margin how much material comes in and sends it back. In that case, the entries are made from the invoice to the stock card.

A MEMBER: In that case, if there was any delay in receiving the invoice, your records would show that the goods are not in stock, and you might possibly turn down sales.

MR. MICKLER: There may be cases like that. Of course, in a large institution it is necessary to have a closer connection between the receipt of material and the entry on the stock cards. That is a detail that can be worked out to suit the conditions in the different municipalities. In your case, of course, where the invoice comes into one place and the material goes into another, you have got to have some record of receipt. The receiving clerk receives a copy of the original order, and that tells him that he has to look for the material and naturally he will have to tell when it comes in.

MR. BLAY: The invoices come in and are registered, all numbered, and sent to me, and I in turn send them all to the receiving clerk. There is a space there for him to O.K. the receipt of the goods, so that he is practically responsible.

MR. MICKLER: He puts his material into stock before he gets the invoice; he has a means of recording his material in before he receives the invoice?

MR. BLAY: Yes, that is the idea, and when he receives it he certifies the invoice and returns it.

MR. MICKLER: That is the way we work it at the Hydro. The Stores Department have the original copy of the order, and when material comes in they make out a receiving slip, and also O.K. the invoice. All copies of invoices go out to them for O.K. before being passed for payment.

MR. BLAY: The receiving slip just shows quantities?

MR MICKLER: Yes. They complete the entry when they get the cost. Sometimes the orders show the cost. I believe, if it is practicable at all, it is best to enter the items right from the invoice, then you have all the details at hand.

MR. McAULAY: I notice, in some municipalities, they make up their return at the end of the year and disregard their stock cards, their return being based on the Henderson Business Service.

MR. MICKLER: They are absolutely wrong. We do not require the Henderson Business Service to tell us the cost of our material. If we utilize the means outlined here of recording the cost from the invoice, and keeping the stock cards properly, we have a better cost system than the Henderson Business Service will give us, because theirs is only a theoretical cost based on quotations from many manufacturers, and sometimes they are three to six months out of date. The pricing from anything but the stock cards is bound to throw you out of balance in your inventory, and, as I say, if you use any other means than

the actual cost you will have trouble in balancing your inventory.

I presume that most of you gentlemen were in the other session yesterday when the Electrical Inspection Rules were read, and I had expected yesterday that questions be asked in connection with the Rules. There are a number of Inspectors here now. If any of you have any questions you would like to ask about the Inspection Rules I would like you to ask them, because there are men here who can answer them. One thing came up in connection with boring a hole through a stone wall to put in a service. I talked to Mr. Hall about that, and he said you can bore through a window frame if necessary to avoid going through a solid wall.

You will notice that there were several very important changes to the Rules. One of them is that the rule in connection with the 660 watt limitation on a lighting circuit has been changed to allow circuits of 1,650 watts capacity, and there is another change affecting the number of bulbs which can be put on to one circuit. I understand that an outlet, is now considered as a tap to a circuit and that if a fixture is attached, can have any number of sockets, also that you can have twelve such outlets where before you could only have twelve sockets per circuit. Is that right Mr. Gaston?

MR. P. T. GASTON, El. Insp. Dept., Toronto: That is, provided the fuses in that circuit do not exceed 15 amperes.

ADVERTISING

by C. M. Pritzker, Curtis Advertising Co., Windsor, Ont.

THERE is no audience I would rather talk to about advertising than this gathering of Hydro Managers.

Many of you are veterans in the use of advertising. All of you are directly interested in advertising for two reasons:

First, you know that your profits on appliance sales help you make a good showing on Hydro reports.

Second, the more appliances you sell, the more power you sell. This, too, helps you better your showing.

Now I am not a mystery man, here to reveal to you some marvellous secrets about success through advertising. There is no mystery about advertising. It is a simple, natural development of modern life.

In one form or another advertising has always existed. Back in the stone age the cave-man shook his club before his fellow rough-necks to advertise the fact that he was able to defend his home against all comers. Even birds advertise. The male pigeon or partridge ruffles up his feathers and does a war dance to advertise his gorgeousness to his prospective mate.

In early days advertising gained a bad name because it was chiefly used to sell worthless drugs and patent medicines. To some extent this is still true, and even to-day many people think of advertising as an unscrupulous means to undeserved wealth. This attitude is rapidly changing

however, as people realize that modern advertising is a legitimate selling force—a worthy educational factor without which the rapid rise in our standard of living would have been impossible.

In the 18th. century advertising began to come into its own. Its applications were crude at first, yet it was a fundamental factor in the sale of goods. A study of advertising from the 18th. century is almost a study of business progress.

Steam and electricity brought an enormous increase in possibilities of production. The cotton trade growth, spread of railways, improvement in machinery and communications—all demanded larger markets and made it possible to reach those markets. A flood of commodities was turned loose on the world. The problem was to sell them.

Meanwhile came the developments in printing and education, which made it possible for thousands to read, where one could read before, the stage was set for advertising.

But not until the last twenty years did advertising begin its really astonishing growth. To-day the applications of advertising are countless. It is like electricity. Nobody knows what electricity is, but it has its many well-understood uses. Just so with advertising. Ask ten men to define advertising, and you will get ten different answers.

My answer is that advertising is the common sense application of publicity to business. I am here today to discuss the common sense application of advertising to *your* business.

I happen to be connected with an organization which was, perhaps, the pioneer in the field of co-operative electrical advertising.

Back in 1906 the electrical industry was comparatively a newcomer in the public utility field. Utility companies in the United States had done very little advertising. Their poles served only a part of their territories, so that they would necessarily waste money by advertising in newspapers read by many they could not possibly sell power to. Also these utility companies often sold gas as well as electricity. They could see no advantage in trying to convert a gas customer to an electricity customer.

This situation obviously called for a continuous campaign of *Direct* Advertising which would reach only those they wanted to reach—and reach them consistently and forcefully.

We pointed this out to their early association of central stations, and the result was a co-operative campaign of several years' duration, which was used all over the country.

The result was that they secured, with the utmost economy, an application of advertising that fitted the times and conditions, and that played a large part in the phenomenal development of power and appliance sales.

It seems nowadays that our electrical conveniences have always been with us. But they are the result of the efforts of advertising pioneers. How else could this great business have been built up in so brief a span of

years?

To-day the privately owned electric power companies are conducting varied publicity activities. Briefly, the purposes of these activities are:

(1)—To increase the use of electric current.

(2)—To promote co-operative methods to this end.

(3)—To promote harmonious relations with the public.

These three purposes really boil down to two:

(1)—To sell more appliances and current to the public.

(2)—To sell the public on the virtue, justice and economy of privately owned electrical utilities.

Let us consider this latter purpose first. Let us quote their organization itself. Under the slogan—"The Public Wants the Truth", they say:

> "Every week we supply to about six hundred newspapers in the United States and Canada a news service which consists of electrical items written in an interesting and informative way.
>
> "No charge is made for this service.
>
> "In addition—we send out a page of electrical facts upon which newspaper editors can base their editorials."
>
> "Results"
>
> "We estimate that in the first three months of this year we received 122,070 column inches of publicity for the industry in those papers to which we send this material."

They then go on to show typical examples of this propaganda—which consists of editorial and news items on the rights and beliefs of public utility coroporations.

Now it is not for me to take either side of this question, but if the private utilities recognize the necessity of presenting their side to the public, through co-operative effort, it would seem that your side too needs expression.

Let me call your attention, here, to your monthly publication—"THE HYDRO LAMP" which is supplied to you by the Hydro-Electric Commission of Ontario. Recently revised to make it more attractive and readable, this little paper is of great value in helping you sell your public on the Hydro idea. I trust each of you is seeing that it reaches all your customers every month.

This HYDRO LAMP is your regular monthly message to your customers. Directly and indirectly it promotes harmonious relations between your Hydro branches and its people in your communities. It aims to create a public pride in Hydro, and a true realization of the great service Hydro is performing.

The true basis of Hydro success is public opinion. Use the HYDRO LAMP to make that basis ever more solid and enduring.

Each issue of the HYDRO LAMP serves another useful purpose. As announced on the cover, each issue is a special number, devoted to a certain appliance or appliances—selling your customers on the desirability of these electric home helps.

Thus you have a regular, always-dependable, base for your advertising effort. That base is the monthly HYDRO LAMP. I believe you should build up on that base a structure of

well-planned advertising and selling that will carry each of you to the heights of success.

Your market for Hydro is divided into three main kinds of consumers—Domestic, Commercial and Power users. Different methods are required to reach each of these. Let us consider the Domestic market first.

Your problem is to sell more appliances in your community, including more adequate lighting systems. When

you sell more appliances you automatically sell more Hydro current.

Here is a chart which outlines a standard campaign on vacuum cleaners. In general, this same campaign is adaptable to almost any home appliance, and is therefore used as an example for all.

The Seven Steps.

Deciding What To Advertise.

This is governed by the season, by the brands of appliances you handle, and by the advertising effort the makers are carrying on at the time.

You naturally would not advertise electric heaters in July, or fans in January. And whenever possible you should try to put your special effort back of the appliance, or appliances, featured in the HYDRO LAMP for the current month.

You sell several brands of vacuum cleaners. Which shall receive the benefit of your major sales effort at a certain time?

Naturally the kind which will yield you the greatest returns—all things considered. Your local conditions will govern to some extent. The maker's newspaper advertising and sales helps may make it advisable to get behind a certain make for a special campaign.

After you have chosen the cleaner, or cleaners, you are ready for the second step of your campaign.

Arranging Your Store Display.

Your electric cleaner display in the store can be made a more or less permanent part of your layout. Experience has shown that the most effective location is at one side of, and a reasonable distance back from the main entrance. There, should be placed a rug and some chairs, the latter for the comfort of your visitors during the demonstration. Make the space as home-like as possible, with a table, table lamp, a floor lamp or two, and two or three electric cleaners. Other appliances, such as irons, washing machines, and so on, can be placed near at hand—for suggestive selling.

Your demonstration talk should be carefully planned and everyone who may be called upon to perform the demonstration be thoroughly instructed. The manufacturers will furnish you valuable information along this line.

Preparing Your Window Display.

Your window display serves to attract attention to your store, but that is only half the battle. After passers-by stop they must be drawn into your store. Curiosity pays no profits till it is turned into action.

Electric cleaners offer unusual opportunities for action-compelling window displays. Here, again, the manufacturer will be glad to help you with material and suggestions.

Newspaper Advertising.

Use all the newspaper advertising you can afford. It is one of your ablest assistants, and nothing can quite take its place.

However, newspaper advertising is comparatively ineffective unless every detail of your selling effort is planned to fit in with it, and reap its full benefits. Newspaper advertising is not a thing apart—it is one of the seven mutually dependent steps of your campaign. So tie in your newspaper advertising with your selling. Use a coupon which asks for a demonstration in the prospect's home.

Fortunately excellent advertisements

are available from the manufacturers. Any other newspaper advertising you do should be planned by an expert—whether that expert is yourself or someone else whose professional advice you seek. The returns you get from newspaper space will depend on what you put in that space. It is important to remember you are not only selling appliances—you are selling your continued services to appliance users, also your easy payment methods, etc.

In general, about 50 to 60% of your advertising appropriation should go for newspapers and the remainder for other activities.

Direct Advertising.

Direct-Advertising should have a definite place in your selling program, for used properly it is one of the most effective forms of advertising you can employ.

Direct Advertising is a specific, definite method of imparting a message to selected individuals or firms.

Direct Advertising is the one sure method of reaching those people you want to reach.

The great mail order houses are concrete testimony to the salesmaking power of Direct-Advertising. Each month they send out carloads of folders, booklets, catalogs, letters, etc., that bring in millions of dollars' worth of business.

You, too, can get worth-while results through Direct-Advertising.

The first essential of Direct-Advertising is your mailing lists. Of course you have a general mailing list of your Domestic Power users. Here you have an advantage over the ordinary electric shop, in that you have this complete, up-to-date, readily available list of Hydro users in your community.

Intelligent, persistent effort will add to this general customer mailing list special lists of prospects for particular appliances. For instance, why not have your meter readers note the homes not yet provided with electric stoves?

In most cases they pass through the kitchen on their way to the meter, and it would take almost no time or effort for them to find out this important fact. It may be possible for you to keep a card record of customers showing what appliances they already have.

Many private appliance dealers employ a young lady to make a canvass of residential districts, to get the names and addresses of women who are at all interested in vacuum cleaners, etc. These names and addresses are listed for direct-mail and personal selling effort. This census saves time and expense in the end.

Your mailing lists are important. There should be someone in your organization responsible for them, as well qualified as possible to keep these lists up-to-date and productive.

Now we come to the using of your mailing lists. You have men who deliver the HYDRO LAMP to the homes in your communities. Why not have them deliver at the same time literature furnished by the manufacturers of the particular appliances featured in the issues of the LAMP? This would be direct advertising of a very opportune kind.

Then you should use the mail. The postman is an effective ally. Your newspaper advertising should be backed up by mailing messages on the

same appliances. These messages can often be folders, etc., furnished by the manufacturers, and might, to advantage, be direct advertising material produced for all of you on some co-operative plan whereby you get better material at less cost than any one of you alone could secure.

Then, too, I do not think any one of your monthly statements to customers should ever go out without an enclosure, or stuffer, advertising some appliance, better lighting, etc. This could be tied in with your current campaign. At almost no extra cost or trouble it will get an effective message into your prospects' hands.

Altogether, you see that Direct-Advertising is a many-sided thing, and that a little thought, ingenuity and effort will show you many ways of using it to your profit. Some of you will always get more out of it than others, but by co-operative effort, under the guidance of some experienced direct-advertising organization, all of you could secure greater results.

Telephone Selling.

The Telephone, properly used, will serve as one of your best salesmen.

Its main purpose, of course, is to pave the way for the demonstration in the home. Sometimes, however, you may be able to persuade the prospect to come to your store to witness a special demonstration. Someone in your organization with a special aptitude for telephone selling should do the talking. Telephone selling is well worth an extensive trial.

House-To-House Selling.

House-to-House selling is the final, and a most important step in your campaign. It is the real "go getter" method of enlarging your business. You have an unusual opportunity to get results this way, for a Hydro salesman enters a house with the immense Hydro prestige back of him, and is greeted in a far more friendly manner than the ordinary house-to-house canvasser.

The all-important thing is that your salesmen be properly instructed. It is fair neither to the salesman nor yourself to take a chance that he will represent you rightly, and make the most of his selling opportunities.

The first rule for the salesman is *Know Your Subject*. He should take a cleaner home and perform all the experiments and operations. He should practice until he can skilfully handle the equipment—even to the comparatively simple matter of connecting the cord to the convenience outlet. He should practice taking off, emptying and replacing the dust bag; taking out the brush and putting it back again; turning the cleaner over deftly and without jar to show the under side, etc.

He should know the use and application of every tool and be able to manipulate each one expertly and easily. All these things should be done until perfect smoothness is attained.

Nothing hurts a demonstration more than to see a salesman handle the cleaner and tools awkwardly, apparently unfamiliar with the apparatus he is selling. Naturally the prospect thinks the cleaner is hard to handle, even for an expert, and the sale is lost.

Demonstration Etiquette is of almost equal importance. Every word and action of the salesman has its effect—good or bad—and no detail is so slight that it cannot win or lose a sale.

Just to show you how complete the training of a good salesman must be, let me quote a few proved points of this demonstration etiquette .

(1)—Step back from the door when it is opened (or stand well back from the door and take a single step forward as you begin your introductory talk.)

(2)—Remove the hat the instant the door is opened, and keep it off as long as talking with the housewife or maid.

(3)—Before entering the house, be careful to wipe all dust or mud from your shoes.

(4)—On entering the house, remain standing until invited to sit down.

(5)—Stand up whenever the housewife stands up.

(6)—If she leaves the room sit down, but be careful to rise when she re-enters.

(7)—Be careful not to touch books or papers lying around.

(8)—Always talk to the prospect in a deferential manner, but with confidence and earnestness. Avoid "lecturing."

(9)—In leaving, thank the housewife for her time and interest.

You will note that only a man of naturally gentlemanly instincts can carry out these instructions successfully. Only such a man is fit to represent Hydro.

As for his selling talk—I haven't time to go into that now. That it is of fundamental importance is obvious. Always remember, however, that the successful salesman sells not appliances but what those appliances will do for his prospect.

Some distributors make use of a woman solicitor who arranges for demonstrations. Both men and women do the demonstrating after an appointment is thus made.

As to the advisability of women, there is no doubt that one woman can talk to another on the subject of housekeeping problems with greater understanding than can the average man. This is but natural when you realize that the woman is, after all, the one who has come through the actual experiences and can appreciate the modern appliances over the old methods which used to make housework a thing of drudgery. The man has come through the same period of development, but not had any actual contact with housework, for after all he is but a man.

There are many ways to success in house-to-house selling. Get all the information you can, and then develop your own methods.

There are just a few facts I should like to present to you in conclusion.

In the first place, you have a great, a unique opportunity. People know their Hydro Shop is absolutely reliable. They feel friendlier to you than to any private dealer. And you can offer them attractive payment terms.

Second, always regard your advertising and selling activities as one single unit—not as scattered efforts. Plan your campaign ahead—as a whole. Every month should have its well organized activities—ties up to the season and the HYDRO LAMP.

Store displays, window displays, newspaper advertising, direct-advertising, telephone selling, and house-to-house selling—all are necessary parts

of the complete sales push. Use to the fullest extent all material, information and advice the makers of your appliances offer you. Ask them for more. They are glad to help you.

Use to the full, also, all selling and advertising helps the Hydro-Electric Commission of Ontario offers you. Ask them for more, too. By this co-operative effort you will accomplish more at less cost.

Other electric organizations are spending constantly increasing millions in co-operative advertising. They find it pays. And they are performing a real service by extending the usefulness of the modern servant of civilization—electricity.

In less than three years the combined advertising appropriations of the members of the National Electric Light Association of the United States grew from nothing to over three million dollars. The Associations' officials predict that within five years this figure will be twenty million dollars. Hydro certainly has not been ahead of the times in adopting advertising—particularly the great modern force of co-operative advertising.

Endless instances might be cited to show what co-operative advertising has done and is doing to-day. Let me mention just one or two—Sunkist Oranges, and Sunmaid Raisins. How familiar those names are to you—and to everyone. Co-operative advertising did it—has brought success and wealth to hundreds of fruit growers who, alone, would now be in the same condition of distress which is oppressing other farmers.

Think of your opportunity! Let me quote some facts and figures about our own Canadian market, showing what the future holds.

Our population is growing, but far faster grows the per capita consuming power of our people. The growth of the per capita consumption on the following items is typical of that in many other directions—particularly in those commodities for which advertising is ever strengthening the demand already created.

	1910	1922
TOBACCO—Increase in per capita consumption per year	2.72 lbs.	3.25 lbs.
	1918	1923
CANDY—Increase in per capita consumption per year	$2.50	$4.60
	1918	1923
COCOA & CHOCOLATE—Increase in per capita consumption per year	1.5 lbs.	2.6 lbs.
	1921	1923
SUGAR—Increase in per capita consumption per year	88.26 lbs.	102 lbs.
	1919	1922
MEAT—Increase in per capita consumption per year	127 lbs.	156 lbs.

In 1923 The Marsh Grape Juice Co., Niagara Falls, Ont., had a sales increase of 40% over 1922.

In 1923 The Shredded Wheat Co., Niagara Falls, Ont., had a sales increase over 10% over 1922.

In 1923 Canada Bread Co., Toronto, had a sales increase over 15% over 1922.

In 1923 Canada Bread Co., Winnipeg, had a sales increase over 20% over 1922.

Four of the largest Motor builders increased their sales by 73%, 35%, 75%, and 50%, respectively.

The Dodge Motor Car Co., reports an increase in sales of over 21% up to the week ending April 25th.

The Raisin Growers' Association reports increases ranging from 20% to 1,000% in the cases of individual retailers as a result of the intensive campaign commenced last autumn.

Salada Tea, one of the most consistently advertised articles, records an increase of 20% in its 1924 sales to date.

Thus the Sales records of firms handling a wide variety of products prove beyond all doubt the possibilities of developing Canadian sales at an even greater rate than the growth in population. If this is true of such staples as sugar and meat—how much more true it is of Hydro—the consumption of which depends only on the education of the public to the benefits of a great variety of electric appliances, including the wiring of the thousands of homes not yet wired for electricity.

Twenty years ago the bankers of the United States refused to loan further sums to the automobile industry, on the grounds that the saturation point had been reached. Yet to-day one maker alone produces more cars each month than the combined yearly output of 1900.

The increase in per capita consumption of most commodities is in ratio to purchasing power. The luxuries of yesterday are bought by the masses of to-day. So long as the advertiser continues to render a needed service to the public, he needs have little fear of arriving at the saturation point.

Among the commercial and power users of Hydro you have at least as great an opportunity as among its domestic users. Industry is not yet electrified as it should be. Stores, factories and hotels need better lighting, better cleaning methods, electric fans, and so on. Here co-operative advertising— both newspaper and direct—will find fields fertile indeed.

The architect, the contractor, the home-builder, are awaiting your message. Wherever you turn, in this imperfectly electrified world, you see people who should be served by more Hydro.

Why let them stumble in darkness? Why not make a more active effort to emancipate them from their unnecessary drudgery.

The age-old force of advertising is ready for these new uses. Each one of you is master of his own destiny in his own community. All of you together are responsible for the future usefulness of electricity in Ontario.

Discussion

MR. A. B. SCOTT, Galt: In the case of a house-to-house canvass, do you think there is any disadvantage in the salesman carrying an article with him, such as a vacuum cleaner

MR. PRITZKER: I think, wherever possible, the ideal thing would be to have somebody get on the telephone and call up so many people every day and make appointments for the salesman. That is my own version of that.

MR. G. J. MICKLER, H.E.P.C. of Ont.: If there are no further questions to ask, I would like to call on Mr. Clark, the Advertising Manager of the McClary Manufacturing Company, to give us a few words on the different problems he has found in connection with advertising electric ranges.

MR. D. GEO. CLARK, McClary Mfg. Co., London: Mr. Mickler and gentlemen, just how to say anything very definite in regard to the problem of the Hydro Shop is rather difficult.

I have followed with considerable interest the work that the Hydro Shops have been doing, and I think it is very creditable indeed. Those shops have done a lot of good, but I am inclined to think that there is one point the Shops do not stress strongly enough. You will observe that the Hydro Shops throughout the country look very much like any other retail store, but do you gentlemen think that you stress sufficiently the point that you are appointed by the people to supply the people? Do you try to instil into the people, the ratepayers who are behind your proposition, the idea that you are theirs and they should use you more, and come to you with considerably more confidence than they do to-day? I think that that is a point that should be used more and more, and I do not think that you will find in any advertising, that point stressed sufficiently. I think you ought to take the people more into your confidence, get them to take you more into their confidence, and give them the idea that you are there not so much as a matter of just marketing the product so much as to put them on the right track as to the proper utensils or appliances to use, the proper wiring of their houses, and everything like that.

I know that your problem is a very difficult one, and that you are open to criticism on every side, but still I think you ought to educate the public more and more that you are there to advise them in their problems.

The Hydro Lamp is a good thing, but I do not think it is getting general enough distribution. I am a great believer in advertising. Newspaper advertising has only one function, and that is the function of broadcasting the message very quickly to the people. However, although there is much advertising done in the daily newspapers, still that is passing, it does not go into the home and stay there. We all know that the morning paper is stale at noon, and the evening paper is in the garbage the next morning. Even the Hydro Lamp can be improved on and be made to stay longer in the hands of the public.

The store display, I do not think it can be criticized. I think the most

wonderful displays we have of any line of merchandise are those displays which we see in the Hydro Shops throughout the country. Your buildings, in the cities and towns, especially where you have had new buildings erected, have been so constructed as to render themselves to display, and I feel that the men in charge of them are using the buildings to the very best possible advantage. Of course, the same thing applies to the window displays.

In regard to the house-to-house canvass, that is something which is a pretty hard proposition to know just exactly how long the people are going to put up with it, or whether it is going to increase, and, to my mind, a good deal depends on the class of salesmen you use. I had occasion here a couple of weeks ago to call on quite a few farmers in connection with a certain survey I was making, and I found that the farmers have not forgotten about the number of gold bricks that have been sold to them in the past. I think there is one concern that has done something towards getting the housewife to entertain the idea of the house-to-house canvass possibly more than anybody else, and that is the Fuller Brush Company. The door is on the latch, generally, for the Fuller Brush man. They do not hesitate about letting him in, and it is due absolutely to the fact of the high quality of their salesmen.

MR. MICKLER: In connection with advertising, I just wish to announce that we are contemplating the issue of a Hydro Merchandise Calendar composed of 12 pages which will be suitably got up from actual photographs, showing the use of seasonal appliances, and it is hoped that every Hydro Municipality in the Province will subscribe for enough of these calendars to distribute to all of their consumers. Already we have orders promised for 160,000 on the simple announcement of the calendar being issued, and we hope that close to a quarter of a million of these calendars will be in the homes of the people of the Province by the beginning of 1925. The front of each page of the calendar, as I said, will contain photographs of the use of appliances, and the back of each page will contain useful household information on the use of the appliances, that is, recipes of different kinds, and other information about the operation of the appliance, something which a housewife will realize the benefit of and will refer to whenever the occasion arises.

I wish you would give the matter some thought and realize the value of this form of advertising. The calendar will hang on the wall 12 months in the year, and the housewife will see it every day of her life and will be able to get some value from it, and that value will redound to the benefit of the Hydro Shop wherever one exists.

Results of Giving Premiums to Stimulate Sale of Electrical Appliances---Discussion

MR. W. H. CHILDS, Hamilton: Mr. Chairman and Gentlemen, Mr. Pritzker said that one must have a thorough knowledge of his subject, but it is a pretty difficult matter for me to stand up here and say that I have a thorough knowledge of this subject. However, we have had certain experience, and this experience we are quite willing to impart to the other delegates here.

I want you to distinctly understand that we do not force our opinions on anyone, but we do think that, in view of the different circumstances, they are entitled to some consideration.

In the first place, in discussing the question of giving premiums to stimulate business, there are a very, very few ways by which business can be stimulated. Increased advertising is one way, reduced prices another. You can all start and fight right now on that basis. Then we have lower down payments as another way, increasing the time of payments, giving a premium on an article that is being sold, and increasing the commission to the salesmen. Those, I think, pretty well cover all of the different forms in which we may stimulate business, at least they do as far as I have been able to give it any thought. Of course, increasing the commission to the salesman has no effect whatever on the buying public.

The last occasion on which we put on a campaign selling washers we increased the commission to the salesmen for a week's sale during August, and, without any further compensation, we sold 26 washers in that time, and we thought that was real business. Then last December we put on another sale, and this time somebody got me in a moment of weakness, and we put on not only an additional commission to the salesmen but a premium. In that ten-day sale we sold 65 washers, in one day 23. In that month, December, we sold 90. Of course, you must realize that we have a big advantage over previous years. In the whole of 1922, in the basement of the City Hall, at Hamilton, we sold 26 washers, and when I tell you that we sold 23 in one day in our new building something is due to the new building and location.

At the end of April we put on another campaign, and in ten days then, with the use of premiums and additional commission to the salesmen, we sold 65 washers. This was immediately followed by a range sale where we gave a set of utensils with each range sold. The advertising showed this range at \$50. During the two weeks of this sale we sold 107 ranges notwithstanding the fact that in the middle of the sale the Gas Company announced a reduction in their price of gas from \$1.25 per thousand to 75 cents, and that, unquestionably, cost us the sale of 50 ranges.

I had the pleasure of writing a little note to the newspapers where we expressed keen satisfaction in being responsible for the reduction in the price of gas. Confidentially, because we are

all here together now, I might say it was keen but it was not very much satisfaction. I might say that I consider we chose a very opportune time. The latter part of April and the early part of May for some reason or other showed a very decided improvement in times, but just as decided as the improvement in times started in the latter part of April and the first part of May, so it slumped immediately after that, and I want to, in fairness, point out that some of our, what I consider phenomenal success in that sale was due to that condition. We put on a sale, starting two weeks ago last Saturday, of washers, and, being Scotch, by absorption and otherwise, I said "Let us not give a premium this time, we will just give an added commission to the salesmen," and while I candidly felt that the sale would not be a success I am still quite satisfied. We spent quite a little money in advertising. The first week of that sale was an absolute failure, no question in the world about that. The President of the Company came in to see me just before the end of that week and he said, "Do you see what we have done," and I said, "Yes, and I see what we have not done," and we decided there and then that we would give a premium. Last Friday's newspapers carried the advertisement that we would give a premium with every washing machine sold during the following week of the campaign, and, I might say, that that applied to anyone who had bought in the previous week . However, that was no better than the previous week. The sale has been a failure.

The point I want to make in this, and I want to be just as fair as I can possibly be, is that from our experience, and at certain times, it most certainly is advisable to put on a sale of appliances and give a premium, that is the conclusion we have arrived at. Take the range sale, for instance, with 107 ranges. While we have the pleasure to-day of having one or two of our salesmen here, I am going to tell you confidentially that they did not draw much money during January, February and March. It was absolutely necessary that they make more money or we were not going to retain their services. That range sale netted them a real good substantial pay working on commission as they do. The added effect of getting a lot of these appliances in use where one sells another must be taken into consideration, and notwithstanding the fact that this year times have been terribly bad I really think that 107 ranges was a good sale for two weeks, and especially in view of the cut in the price of gas.

I would like to point this out. If a customer comes to you and says I want to buy ten ranges for an apartment house, you will give him a discount of at least 10 per cent. on those ranges on account of the quick turnover. Now I ask you which is the better business, giving a 10 per cent. discount to an apartment house owner on account of quick turn-over, or a total of 4 per cent. which it cost us in the range sale that we put on advertising premiums. That is what it actually did cost, because the total cost was carried between ourselves and the manufacturer.

It gives me a good deal of pleasure to be here at this meeting. You all know that you are welcome at our

establishment. We take a peculiar and particular delight in having you there; we have nothing to hide and we have quite a lot to show. If you gentlemen will drop in any time at all we will be very glad to show you everything that we have to show, and you will have noticed that in the advance copy which was sent out of the programme while other people were going to give you a paper I was simply going to lead the discussion on this subject and that discussion is now open .

MR. A. J. MICKLER, H.E.P.C. of Ont.: Mr. Blay, have you had any experience with the giving of premiums?

MR. G. W. BLAY, London: Yes, we have had some experience very similar to that as outlined by Mr. Childs. We are highly in favour of giving premiums. One thing though in connection with using a premium is that we find it is vitally important to get the premium to the house before or at the same time as the appliance which you have sold. We find that a woman who is getting a hamper, or an ironing board for nothing, seems to be more interested in receiving the hamper or ironing board than she does the appliance that she invests her money in so that, as I say, it is vitally important to get the premium there at least with the appliance when it is delivered.

We have had a campaign on ranges similar to that outlined by Mr. Childs, but we did not sell quite as many as he did. We attribute it largely to the fact that we were giving away a premium. We have used them with washers and electric ranges, and they have certainly increased our sales, and we are highly in favour of using a premium.

MR. R. E. GARRETT, Sarnia: Regarding the giving of premiums, I have noticed in several advertisements in the papers of different premiums being made, and those premiums ran from $2.00 up. A few weeks ago I noticed in a paper, which is circulated through Western Ontario largely, a premium of $17 on a $130 range. I would like to know if that is about the right limit to go, $17 on a $130 range, or a basket, an ironing board, or an iron, which costs in the neighborhood of about $3.

MR. BLAY: Mr. Garrett is hitting directly at me. For Mr. Garrett's information and the information of everybody here, that premium, which was worth $17, cost the London Hydro Shop $2.50, and we do not care who knows it.

MR. GARRETT: If you are advertising a heater as selling for $17 and that cost $2.50, I do not think that the Hydro of Ontario were justified in advertising a thing for $17 that cost $2.50.

MR. C. W. HAGUE, National Electric Heating Co., Toronto: I might be able to throw a little light on this point that has come up. Mr. Blay says the premium cost $2.50, it did, and as is the case with the campaign Mr. Childs spoke of, in this particular campaign the cost was met fifty-fifty by the manufacturer and the Hydro Shop. The heater in question was one which the manufacturer recently discontinued, and we were willing to dispose of them practically at cost figures. It had never been sold at less than $17. As I say, that heater cost Mr. Blay $2.50 and we figured

it cost us $2.50. That heater has been discontinued and there are no more after these have been sold.

MR. CHILDS: Mr. Chairman, some of these figures might perhaps be interesting to you. During our range sale which was advertised, and we made a real splash of the advertising, the price was set as low as $50. I may tell you, of the ranges sold the average price was $124. People would come in to see the $50 range, and we had one there—and we have still got it—we are going to send it back—and you would be surprised at the number of people who came in to buy that $50 range and walked out with a $170 one in their arm, as it were. Our advertising was $387 on that range campaign. Show cards for the window $12.25; $40 for advertisment writing, $10 for a cut of the advertisement, $2.89 for an ink etch, and our premiums amounted to roughly $450.

I do not think that Mr. Blay was going out of his way in advertising that appliance at $17. It seems we must fool people for their own good. I had a neighbor and she did not have an electric range, and I had been talking to her for a long time about buying one. Eventually she did buy one, and I called her up a couple of weeks after. I said, "How do you like your range?" and she said, "Mr. Childs, I haven't any idea in the world how I ever got along without it before." I offer no apology to any man in this place, or to the public for the electric appliances that we sell.

MR. MICKLER: Mr. Phelan, have you had any experience with the giving of premiums in Windsor?

MR. D. J. PHELAN, Windsor: In Windsor we are absolutely opposed to giving premiums. We believe it is not right, it is simply another way of cutting prices and, of course, we do not believe in cutting prices.

A short time ago we put on a sale of the same washers Mr. Childs speaks of, a down payment of $5 monthly, with a weekly payment of $3. That gave us in the first month $17. The regular down payment on the washer is $14, so we had actually more than our down payment in the first month. The results were what we considered very satisfactory. We more than doubled our washer business in any previous month. As a matter of fact, I think we sold about 47 washers. The only thing about the premium business is I cannot see where it is going to end. I would like to know what would be about the limit. The premiums run from electric irons, clothes baskets, vacuum cleaner attachments, and so on. I would like to hear from some manufacturers what they think. Mr. Childs did not say how many ranges or washers they sold after the sale was over. I think it makes the business spotty. I know of at least one manufacturer who is giving a premium at the present time simply because it was introduced by another one.

MR. A. M. SMITH, McClary Mfg. Co., London: I do not know that I have very much to say. It seems to me that stimulation of business is one thing the manufacturers had in mind when they promoted this premium campaign. I think it has to be analyzed from the position of cause and effect. In our case, we had in mind the fact that business was dragging a little, and we thought we would try it out

and see if it would stimulate business and it did. I do not believe it is anything we can continue with success for any length of time. It seems to me it is up to the manufacturers, in co-operation with the Hydro Shops and other dealers, to work out some of these problems from time to time. As Mr. Phelan says, it is spotty. There are places where the thing does not go across at all, and I do not believe it is good business to offer that inducement in those places, but in the larger centres something of the kind is certainly conducive to good business, but I think there should be a limit on the money expended in that direction. It must be covered by good advertising or you do not get the results.

MR. HARRY BLOOM, Coffield Washer Co. of Canada, Hamilton: Gentlemen, I wish to say that, under present conditions, it has been found necessary to use some new method as a stimulus to business. We all need a stimulant now and again, but the most important factor that we should all remember is this, all things can be overdone.

We have proven to ourselves that to offer premiums as a continuous method is a big mistake, and as soon as conditions become more normal it would be folly to continue premiums to stimulate sales. We have proven that it has been successful, but to attempt to repeat it would be very unwise. New methods, of course, should be applied from time to time. They should be original, and absolutely truthful. You have got to be fair to the people as well as to yourselves.

It is in the minds of many that it is reducing the selling price. That is not the view that should be taken, because it is not actually a fact while in one sense of the word it may appear to be so. It is simply offering one method of suggesting to the prospective purchaser that now is the most opportune time.

The question has also been asked as to whether it has reduced business after the sale is over. That depends largely on the effort your salesmen put into their work. This last sale has proven to us that the time must be opportune to make your sale a success. I think that covers the point Mr. Phelan had reference to, perhaps.

MR. PHELAN: There is just one more angle to it that I did not mention when I was on my feet.

Some time ago—I am not saying this in a criticizing manner—all the Hydros located in the border cities put on a sale a short time after we did and gave away a premium of an iron, on the sale of the same washer. As you all know, some people take the view that we should promote the idea in the people's minds that the Hydro is theirs. There is no question about it that the people are paying for those premiums indirectly, and if the people are paying for this why should the people that do not buy ranges or washers during a sale pay for the premiums to give to these other people? I am not saying whether it is right or wrong, mind you, but that is a criticism you leave yourselves open to. If I buy a range to-day and my next door neighbor goes in to-morrow and gets a set of utensils with her range, I have paid the full price, why shouldn't she do the same? She gets these utensils for nothing, something which I will have to pay for indirectly, of course. A local dealer came

in and mentioned the fact. He wanted to know why the Hydro should be able to give away something for nothing for which he was helping to pay, —the supporters of Hydro. We, of course, always try to promote goodwill amongst the other contract dealers, and we feel it would not be good policy on our part to invite that sort of criticism.

MR. C. T. RUTLAND, Moffats Limited, Weston: About the premium proposition being Scotch. It was hard for our company to get started, but other manufacturers have started something and, of course, we have to follow. We were not in favour, in the first place, of giving premiums. We are satisfied with the result as far as premiums are concerned, and it is open to any Hydro Shop in Ontario, because there is no distinction.

As Mr. Childs said, when business is slow no doubt the premium is going to help stir it up. As a rule, when in business you have got to do what the other fellow does.

MR. CHILDS: In answering Mr. Phelan, I would like to say this. Premiums, in my opinion, are a form of advertising. Nobody questions how much you pay in the newspapers for advertising. We have had people who came in and said, "I bought a washer last week and did not get a premuim with it." They are critical. To tell you the honest truth they often get worse than that, but it is an advertisement and we have conscientiously tried to consider it that way. You figure on a certain number of washers or ranges, and if you sell more than that number you win, and if you sell less you lose.

Business at the present time certainly needs a stimulant. I do not think there is any gentleman here who knows the conditions as they exist who would be bold enough to say that business is good. It has been suggested that the Hydro Shops should not have any advantage over the other dealers, but neither should the Hydro Shop be handicapped. They all do it, it is done in every line of business. They do it with Fire sales. We almost put one on the other day simply because a little smoke got in, but are we going to sit down and be handicapped?

MR. T. F. MOULTON, D. Moore Co. Ltd., Hamilton: There has been one thought in connection with this premium-giving business that has not been mentioned this afternoon, and which we run up against, and this is particularly true of the larger centres, Toronto, Hamilton, London and places like that. Mrs. Jones happens to be in Hamilton, and the Hydro Shop strikes her as being a particularly good place for her to nose around a good bit. She goes in and looks at everything there is, and there happens to be a campaign on in electric ranges. She comes from Brantford, and she wants to pay cash and buy the range right there. We thought perhaps she had better buy it from Brantford, because she would have better service all the way through. Well, she goes to Brantford and wants to buy a range, has the money all there, and she raises the Devil because she cannot get this $5 article for nothing that she could have got in Hamilton. It is harder, of course, on the smaller Hydro Shops in towns not so large as Hamilton to do these things and get away with them as well as Hamilton or London

do it. We were forced in that instance to dig right down into our pockets, in order to get the sale, turn around and give Mrs. Jones an iron, or whatever the premium was that was being given away.

MR. SMITH: Perhaps intentionally or otherwise, Mr. Rutland mentioned that he followed what other manufacturers do. Occasionally, the boot is on the other foot, they sometimes start something and then we follow.

This whole proposition of premiums seems to me to be one of conviction. The manufacturers themselves have to be convinced that it is going to be the proper thing to do, and I think the Hydro or the electric appliance dealers have to be of the same frame of mind.

MR. GARRETT: Are the Hydro Shops justified when business is poor and money scarce in going out and offering bribes, as it were, to these people when they haven't any money really to buy the things with?

MR. SMITH: Is there any difference between these premium sales offering the public something as between departmental special sales day which is, I say, on the same basis?

MR. GARRETT: Of course, Mr. Chairman, there is one other thing to consider in this. The Hydro Shops in Ontario are supposed to be on a par, everybody is supposed to be able to do things that everybody else does. Take an independent electric dealer, or departmental store, the public have no particular interest in them as they have in their own institution, and they are perfectly pleased to see the independent dealer do pretty nearly anything he wants to do. You have to consider, though, that Hydro is more or less a public institution.

MR. CHILDS: The Hydro is a public institution, there is no question about that, and we are not on a par either, because one municipality has certain costs for buildings that another municipality has not. There is no reason in the world why another municipality should have the same costs. Each and every municipality is absolutely separate. It is that competition that has made the success of Hydro. Conditions may be different in Hamilton than they are in Toronto and even in London. There is no doubt we must meet these things just as you would do if you were putting your own private money into a concern. I candidly and honestly say this, that so far as our sales efforts are concerned in Hamilton, which I am responsible for, if my own personal money had been invested in that sale I would have conducted it in exactly the same way. Really, premiums do seem to have the effect of putting over a sale. You cannot tell me, when you sit down and analyze it, that a woman is going to buy a range or a washing machine because she is going to get a $3.33 article. The average price of the range was $124, and the price of the appliance was $5.81, on which we split the cost. If the woman or the man himself sat down and started to figure it out and said, "I am buying that range because I am going to get $2.90", or some such figure, he would not buy it. But the fact remains that he did buy it. It does slow up business after a sale, to some extent. Salesmen lie down, they just simply quit, it is not coming just as soft as it was before, but it does not take them long to get

started again.

We must not be handicapped, we must all be together. It is a public utility, of course, we admit that. Still, just because one makes a mistake you do not have to say they have all got to go out and make a mistake, and because one makes it a success is it necessary that they all will, because they won't, not yet.

MR. BLAY: I am very glad to say that things are different in London than they are in Hamilton.

Mr. Phelan wanted to know if business was spotty. We find it so spotty that it is beginning to smell, and when the smell gets sufficiently strong we put on a little premium campaign to sweeten it up and believe me it does.

Another gentleman's argument is that being a public utility everybody is helping to pay for the premium that some individual is getting. Very true. As a public utility in London we operate playgrounds and parks as well as our electrical department, and we supply more than 50 per cent. of these playgrounds, and a golf course. Possibly 10 or 20 per cent. take advantage of the playgrounds, and the other 80 per cent. help to pay for that, so what is the difference

Mr. Garrett spoke about a $17 heater. If we can buy the heater for $2.50 and give it to the people for nothing and the list price is $17, I do not see that it matters much.

Some appliances are closely associated with the articles you are selling. If you are selling an electric range cooking utensils are the proper thing to give them, and if you sell a washing machine you can give an iron. But what I would like to know from Mr. Garrett is how he put over that circulation campaign.

MR. GARRETT: That is a different story. My idea is this, that the Hydro Shops in Ontario should be above advertising an article for $17 that cost them $2.50.

MR. BLAY: They advertised the list price of the article at $17, which is true.

MR. GARRETT: I think the Hydro Shops should be open and above board, and they should not advertise an article for $17 that cost $2.50.

MR. BLAY: Then you think they should have paid about $14 for it.

MR. GARRETT: Yesterday I noticed washing machines on sale for $150, $2.75 a month for a little washing machine. That I claim is not right. I do not think that $2.75 a month is enough to pay on a $130, $140, or $150 machine.

MR. CHILDS: Mr. Garrett, when did you come down?

MR. GARRETT: I was through Hamilton yesterday, Mr. Childs.

MR. CHILDS: I came down the day before, they must have changed the sign, but I am going to tell you something. We never sell any machine at any such figure. We do sell them, though, at $2.50 down and so much a month, and the whole sum total must be paid in a year, and we have never gone beyond that period with the exception of maybe one or two cases where I personally knew the people and knew they were all right. You are entirely mistaken when you state that figure.

MR. GARRETT: Possibly it was $2.50 a week.

MR. CHILDS: Well, then, you

should read the sign that way, you should not stand up and say $2.50 a month. It does not make any difference at all, as far as we are concerned, what amount is paid down, the whole amount has to be paid in a year.

MR. GARRETT: It is information I am after when I am up here, and I would like to know this: Everything you sell, do you say that that must be paid in one year from the date of purchase?

MR. CHILDS: Absolutely, and I want to further say this that the general public do not pay the cost in Hamilton of the clothes hampers, purely and simply because we operate at a profit, and the general public never has had, since the Hamilton Hydro has been instituted, to pay any portion of the cost of that.

MR. D. B. McCOLL, Walkerville: In this discussion, there are certain objections, and there are a great many things in favour. Walkerville has run a few premium sales, and we believe they have been very successful. We did not start with the idea that we were giving something away for nothing, we figured on spending a certain amount for advertising. It would mean doing over double the sales, and I believe it is something that you can figure as part of your advertising cost, and this is an illustration of what actually happened with us.

For a period of three months on a certain washer, and it does not happen to be the one we have had under discussion, we spent each month a certain amount in advertising that particular washer. We decided to try it out on a premium basis. We sold 85 washers, and figuring out the cost of advertising for a 10-day sale we got a greater volume of sale in ten days with the premium than we did in the previous three months. Including the cost of the premium we found that our approximate sale was one-half of one per cent. less per machine than it was during the 3-month period previous to that.

Before sitting down, I would like to move a hearty vote of thanks for the discussion that Mr. Childs brought up. I think it has been very illuminating. At the same time, I would like to go on record as being heartily in favour of those merchandising meetings.

MR. PHELAN: I would like to ask Mr. Kelly if he has anything to say.

MR. T. F. KELLY, Hoover Suction Sweeper Co., Hamilton: I do not know that there is very much for me to say. I think it is pretty much a matter for the manufacturer and the manager of any Hydro Shop. Some manufacturers find that business conditions generally are slow; they find that they have to reduce the price of their product. Others find that they have to give something away, and I know it is true that others find they can increase their price and still increase their business.

MR. CHILDS: Mr. Chairman, I would just like to say for the Hoover Company, which company Mr. Kelly represents, that he is in a very awkward position, because his company forbids premiums in any way whatsoever. I might say that the Hoover Company are, without question, top notch when it comes to maintaining prices. While Mr. Kelly's own personal opinion may be one thing or an-

other, he must express an opinion candidly, and it would not be fair if he were to express an opinion in opposition to the wishes of his company.

Report of Committee on Standardizing Prices

MR. G. J. MICKLER, H.E.P.C. of Ont.: At the Convention in January a Committee was appointed, as you all know, to look into the matter of standardizing prices, so far as it was possible in Hydro Municipalities, of electrical appliances. The Committee that was appointed held a meeting in London some time after that Convention and passed one or two resolutions.

Mr. Blay, Chairman of this Committee, has asked me to read the report of that Committee meeting, but unfortunately I have mislaid it at the moment. The gist of the resolution was this: In discussing the reasons for either standardizing prices, or raising prices, or asking for increased discount from the manufacturers, it developed that before we could consistently ask anybody for more money we must know how much more money we need, and before we know how much more money we need we have to know our operating costs, and know how much profit we are making, or how much loss we are sustaining in doing business. As the real means of obtaining results of that kind lie in the establishment of an accounting system for developing figures, a resolution was passed first of all recommending that every Hydro Shop of any consequence, and most of them are of some consequence, establish a uniform system of accounting, as laid out in the pamphlet that you have seen, the one that was discussed this morning either in toto or as suits the municipality's own conditions, and that operating reports of the different municipalities showing the result of their operations, be analyzed in order to measure the amount of increased discount, or increased price that a shop must receive in order to do business on a profitable basis.

Following the meeting, it was resolved also to send a questionnaire to all of the municipalities selling ranges. We did not take all of the electrical appliances at first, because it was a pretty big job to get the data in and get it tabulated. A questionnaire was sent out asking for the price electric ranges were being sold to the consumers, and we tabulated the results that were received from 37 municipalities, and I may say that there is quite a variation in price among Hydro Shops in Ontario. No attempt was made to find out what prices were being charged in municipalities by electrical dealers.

The variation was so marked that it is felt that a greater co-operative effort should be made to establish at least in the Hydro Shops a uniform price for not only electric ranges but all other electrical appliances.

I will just read some of the variations in one or two different types of ranges. Here is one range, the list price of which is $155. Town No. 1, $155, Nos. 2 and 3, $150; No. 5, $148.75, and right across so it goes

to No. 18, $140, and then four or five more are $155; No. 34, $150. There is a variation of approximately 10 per cent. in the price. That was a popular range.

Another popular range the sale price of which was $140 varied from $130 to $155, almost 20 per cent. difference in price.

It is little wonder that there is a lack of confidence created in the peoples' minds toward the Hydro Shops; if a consumer in Toronto goes to Hamilton, or a consumer in Hamilton goes to Stratford, or a consumer in Stratford goes to St. Thomas, they ought to see on display in each of these different municipalities similar appliances at one price. Whether that price be high or low depends entirely on the average operating results in the Hydro Shops.

You all saw this morning tabulated the results of the operations of eight shops, and you can see that the operating profit in these eight shops is mighty small. It is too small to allow any leeway in overhead or to cover unforeseen conditions which might arise, and which have already arisen in the past four months when business dropped down, and you will all agree without exception I believe, that in the majority of electrical appliances the margin of profit is hardly sufficient to cover all of the legitimate operating expenses. You might question the veracity of that statement. With the majority of electrical appliances with a discount of 25 per cent. or upwards, and 25 per cent. is almost the prevailing discount, we ought to show a larger margin of gross profit on sales. You will notice in town No. 1 gross profit averaged 20.8 per cent. of the sales; Town No. 2, 20.7; Town No. 3, 25.9; Town No. 4, 17.6; Town No. 5, 26.1, and so on.

Those percentages were not arrived at by deducting the actual cost of the material from the sale price. There are items of cost that have entered into the majority of those figures the expense of which must come out of the sale when it is made, and out of the margin that the manufacturer allows. I say that the average percentage of net profit varying from 1.2 per cent. to 7.8 per cent. is hardly sufficient to cover legitimate operating expenses in a Hydro Shop. Of course, some Hydro Shops are saddling themselves with expenses that the other fellows are not called upon to meet. At the same time, I know the cry is going abroad that some margin of profit must be realized in order that expenses may be more easily met and depressions in trade taken care of without seriously handicapping the operations of the shop and contractor dealers as well.

In Town No. 2, the net profit is 1.2 per cent., and that, you will realize, is about equal to the cash discount. If they did not get their cash discount after the invoice comes in, why, they are out of luck.

List of Electrical Material, Devices and Fittings

Approved by The Hydro-Electric Power Commission of Ontario in July 1924.

Appliances

THE ROBBINS & MYERS CO. OF CANADA LIMITED, Brantford, Ont.
Fans and Portable Motors.

* * *

MASON & RISCH LIMITED, 230 Yonge St., Toronto.
Electric Player Piano.

* * *

NORTHERN ELECTRIC COMPANY, LIMITED (Submittor), 131 Simcoe St., Toronto, Ont.
THE WESTERN ELECTRIC COMPANY (Manufacturer), Chicago, Ill.
Electric Ironing Machine.

* * *

SUMBLING MACHINERY COMPANY, LIMITED, 7 St. Mary St., Toronto.
Electric Ironing Machine.

* * *

HEINTZMAN & CO., LIMITED, 197 Yonge Street, Toronto.
Electric Player Piano.

* * *

BURROWES MANUFACTURING COMPANY, 611 King St., W., Toronto, Ont.
Portable Electric Oven.

* * *

THE BRANTFORD OVEN & RACK CO., LIMITED, Brantford, Ont.
Electric Bake Ovens.

* * *

DOMINION ELECTRIC COMPANY, Winnipeg, Man.
Hot Plates, Cat. Nos. B.100, B.101, B.102.

* * *

*FREDERICS, INC., E., 665 Fifth Ave., New York, N.Y.
Permanent Hair Waving Machine.

* * *

*ATLAS ELECTRIC DEVICES CO., INC., 360, W. Superior St., Chicago, Ill.
Lamps—Arc, "Type C Fade-Ometer".

* * *

*REYNOLDS ELECTRIC CO., 2650, W. Congress St., Chicago, Ill.
Food Mixing Machine "Reco".

* * *

Switches

HESSCO ELECTRIC MANUFACTURING COMPANY, 65 Frederick St., Toronto,
Fuseless Attachment Plugs.

* * *

THE DEVOE ELECTRIC SWITCH COMPANY, 414 Notre Dame St. W., Montreal, Que.
Cartridge Fuse Adapters, Cat. Nos. 4000 to 4005 inclusive.

* * *

CANADIAN GENERAL ELECTRIC COMPANY, LIMITED, 224 Wallace Ave., Toronto.
C.G.E. Plug Fuse Cut-out Bases.
Enclosed Switches—Fused—Sheet Metal Cases.
Single and Double Pole Plug Fuses, Cat. Nos. C.G.E.1001, C.G.E.1002.
Cartridge Fuses, Cat. Nos. C.G.E. 2031, C. G. E.2061, C.G.E.2101.
Two-pole, Solid Neutral Cartridge Fuses, Cat. Nos. C.G.E.3031, C.G.E.-3061, C.G.E.3101.
Plug Fuses, Cat. No. C.G.E.1003.

*Anderson Mfg. Co., Albert & J. M., 289-93 A St., Boston, Mass.

Automatic Switches—Clock-operated Type, Types F, G, H, K, N.

* * *

*Hart & Hegeman Mfg. Co., The, 342 Capitol Ave., Hartford, Conn.

Surfaces Switches (as listed on Underwriters' Laboratories Card dated July 8, 1924).

* * *

*Precise Mfg. Corporation, 254 Mill St., Rochester, N.Y.

Automatic Overload Switch "Protector No. 1200".

* * *

*Gordon Electric Mfg. Co., The, Waterville, Conn.

Knife Switches, Cat. Nos. 701, 703.

* * *

*Banfield & Sons Ltd., W. H., 370-386 Pape Ave., Toronto, Ont.

Push Flush Switches "Banfield", Cat. Nos. 2901, 3901, 2902, 3902, 2903, 3903.

Surface Switches "Banfield", Cat. Nos. 2000, 2001, 2047, 2048, 2602, 2604, 2753, 2754, 2900, 2017, 2050, 2392, 2394, 2610, 2763, 2764, 2456, 2606.

Fittings

Canadian Westinghouse Company, Limited, Hamilton, Ont.

Wire Connectors.

* * *

*Weiss & Biheller, Inc., 584-586 Broadway, New York, N.Y.

Wire Connector.

* * *

Miscellaneous

*Standard Flexible Conduit Corporation, 158-160 Eleventh Ave., New York, N.Y.

Armored Cable.

Flexible Steel Conduit.

* * *

*National Conduit Co., Ltd., Dufferin & Queen Sts., Toronto.

Elbows for Rigid Conduit.

* * *

*Jordan-Roberts Sales, Ltd., 22 Dalhousie St., Brantford, Ont.

Lamp adjuster "Autex" No. 6.

* * *

*These devices are under the Underwriters' Laboratories re-examination or label service.

New Government Regulations

Regarding Display and Sale of Electrical Appliances in Ontario

The attention of electrical manufacturers, jobbers, agents, dealers, and all others concerned is directed to Section 17 of the Power Commission Act, 1924.

The following is extract from the Rules and Regulations which have been approved by the Lieut.-Governor-in-Council:—

100.—General Rules.

101.—No person or persons shall use any electrical equipment unless and until a certificate of approval therefor has been issued by the Commission.

102.—No person or persons shall dispose of any electrical equipment other than that which has been approved without furnishing with it a legible notice that its use in the Province of Ontario is unlawful.

103.—No person or persons shall dispose of any electrical equipment in such condition that its ordinary use might create conditions hazardous to life or property, whether or not such electrical equipment has been approved by the Commission.

104.—No person or persons shall make representations whether by advertising, labelling or in any manner whatsoever, which might lead to or encourage the use of any electrical equipment in any location or on any electrical circuit or in any manner which might create conditions hazardous to life or property.

105.—Any person or persons disposing of any electrical equipment in regard to which there might be a probability that it would be used in any location, or on any electrical circuit or in any manner likely to create conditions hazardous to life or property shall furnish with such electrical equipment a plainly printed notice, in form specified by the Commission, indicating in what locations or on what circuits or in what manner its use is safe or unsafe.

106.—The submittor shall comply with these Rules and with such amendments thereto as may from time to time be issued by the Commission and approved by the Lieutenant-Governor-in-Council.

107.—The submittor, after receiving approval, shall maintain the standard of design, construction and materials required by the Commission, otherwise approval may be withdrawn.

108.—All electrical equipment shall comply with the Commission's Specifications for test and approval of electrical equipment, and with such amendments and additions thereto as may from time to time be approved by the Commission.

200.—Rules of Procedure Respecting Approval.

201.—The submittor shall make application on the Commission's standard form of Application for approval of electrical equipment.

202.—The submittor, at the time of making application for approval shall pay the fees prescribed by the Commission in respect of approval of such equipment.

203.—The submittor, as directed by the Commission, shall furnish one or more samples of the electrical equipment of which he desires approval, for the purpose of inspection and test.

204.—Before approval will be given, the submittor shall sign the Commission's standard form of Agreement, which provides for periodic inspection and test of samples of approved electrical equipment.

205.—The submittor shall admit the Commission's inspectors at any reasonable hour to his land, building or premises for the purpose of carrying out periodic inspections and tests of approved electrical equipment, and the submittor shall furnish samples as selected by the inspectors for the making of such inspections and tests.

206.—The submittor shall furnish samples as directed by the Commission for the purpose of laboratory inspection and test.

207.—In the event of failure of any submittor to comply with these rules and regulations, or with the specifications in respect of the approval of any electrical equipment the Commission may cancel the approval of such electrical equipment.

208.—In the event of cancellation of approval, the Commission may require the submittor, if he desires reapproval, to make a new application and submit samples as if approval had never been granted.

ATTENTION IS SPECIALLY DIRECTED TO THOSE RULES PROHIBITING THE SALE OF UNAPPROVED ELECTRICAL EQUIPMENT, WHICH RULES WILL BE IMMEDIATELY ENFORCED.

Hydro-Electric Power Commission of Ontario

THE BULLETIN

Published by
HYDRO-ELECTRIC POWER COMMISSION
of Ontario

190 University Avenue
Toronto

Subscription Price $2.00
Per Year

Queenston-Chippawa Power Development

By F. A. Gaby, Chief Engineer, H.E.P.C. of Ont.

THROUGHOUT the period of preliminary study of the Queenston - Chippawa power development and later as the design progressed, continuous use was made of models of the various structures in order that the mathematical analysis might be augmented by actual demonstrations under the assumed conditions. Models were made for the studies of the intake, the bends in the canal, the transissions, that is, point where change of section occurred in the canal, the diffuser at the mouth of the forebay, and of the draft tubes and station substructures. It is believed that the beneficial results of such studies and of the care taken in the design of what are often considered minor elements of a power development have been demonstrated by the results obtained. Such tests as have already been made indicate conclusively that there has been secured at least as high an over-all efficiency as has ever before been obtained.

True conservation of the waters of the Niagara River for power purposes demands that practically the whole fall of about 327 ft. between Lake Erie and Lake Ontario be utilized. The various power plants now operating at Niagara Falls utilize heads of from 130 ft. to 210 ft. only and with widely different degrees of efficiency. The Queenston-Chippawa power development, the first unit of which was placed in operation during December, 1921, will have a normal operating head varying from 294 to 305 ft. when the installation is complete. The conservation of head effected by the reduction of hydraulic losses to a minimum and by refinements in the design of the various essential elements of the project as a whole, has resulted in a power development which is believed to represent the best in modern engineering practice.

The present installation will consist of eight 55,000 to 60,000 horse-power turbine units operating at 187.5 rev. per min. The generators are of 45,000 to 55,000 kv-a. capacity at 12 kv., 3-

CONTENTS

Vol. XI. No. 9

SEPTEMBER, 1924

phase, 25 cycles . The electrical energy is transformed from 12 kv. to 110 kv. for transmission. Eventually, the plant will consist of ten units, with an ultimate capacity of from 550,000 to 600,000 horse-power. Six of the units are now in service developing 350,000 horse-power, which is being delivered to the existing 110-kv. system known as the Niagara System, including the municipalities of Toronto, London and Windsor (opposite Detroit), Sarnia and intermediate municipalities.

On the accompanying map, Fig. 1, is shown the relation of the various works comprising the development. Water is taken from the Niagara River about one mile above the Falls, is conveyed through the improved section of the Welland River, a distance of 4½ miles, thence by a canal 8½ miles long, to the forebay and screen house on the Niagara River about one mile south of

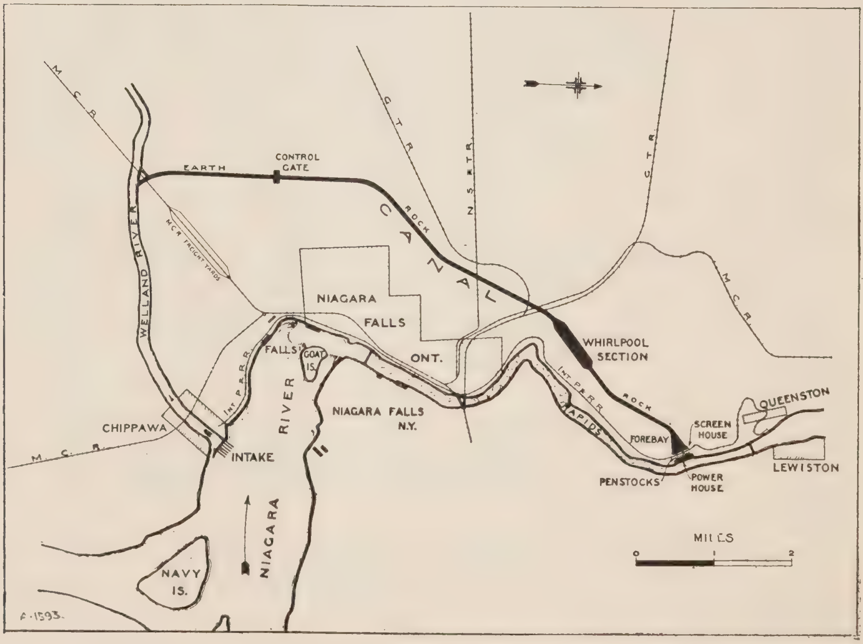


Fig. 1. Map of The Queenston-Chippawa Development

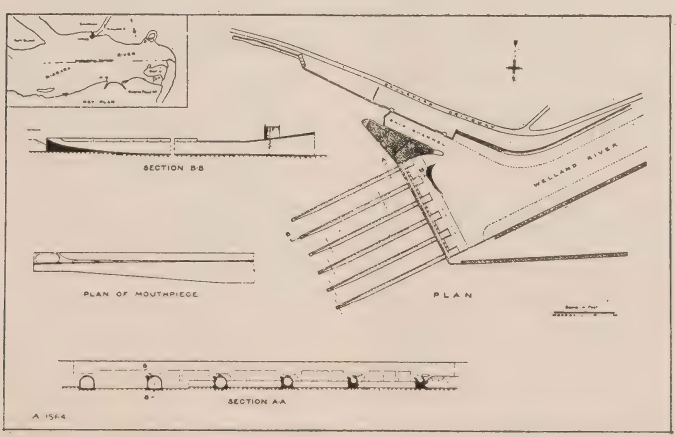
the village of Queenston. From the screen house, steel penstocks encased in concrete, convey the water down the cliff to the power house, from which it passes to the lower Niagara River.

One of the great obstacles to be overcome in order to secure continuity of service is the entry of ice into the canal. Great fields of ice, formed in Lake Erie with its shallow bays and shores, are discharged down the Niagara River every spring, and at frequent intervals during the winter. The river itself never freezes over, but considerable anchor and frazil ice are developed at times of low temperature.

The site of the intake of the Queenston-Chippawa power development, at the mouth of the Welland River, is favorable in that floating ice does not ordinarily follow the shore lines at this point; but the smooth gradient of the river surface, and the comparatively shallow water with its low velocity, is unfavorable to the proper handling of ice.

The removal of water in large quantities from a river heavily charged with ice is always a difficult problem, but is greatly simplified when a natural break in the river surface, accompanied by a sudden drop, gives a source of power for the separation of floating ice, and for its continuous disposal. The use of a horizontal diaphragm to skim the surface water with its burden of ice from the lower strata, thus permitting the upper water layer to be accelerated and removed clear of the intake without objectionable eddies, while the lower layer, free of ice, is changed in direction and flows through the intake into its new channel, gives a positive and satisfactory solution.

The complete intake structure is about 1,100 ft. in length and is made up of an entrance with lock gates for navigation, a bulkhead section and the intake proper, the latter combining two forms of intake. The conventional or surface intake consists of a concrete barrier or boom with fifteen openings each 18 ft. in width, having normally 8 ft. of submergence, which, however, by means of drop gates can be increased to any amount up to the full



Plan and Sections of Canal Intake on Niagara River

depth of water, or 35 ft. The submerged intake consists of six gathering tubes or draft distributors, aggregating 675 ft. in length. Water enters the tubes on the upstream side through slots along a distance of 500 ft. These tubes are controlled by gates similar to those on the surface intake—air tubes comprise an outer tapering section wherein the velocity is maintained constant, with a longer inner section of twenty-foot diameter wherein the velocity increases regularly with respect to distance along its axis. Diffuser sections are situated at the inner end to reduce, with as little loss as possible, the velocity to correspond with that in the Welland River section.

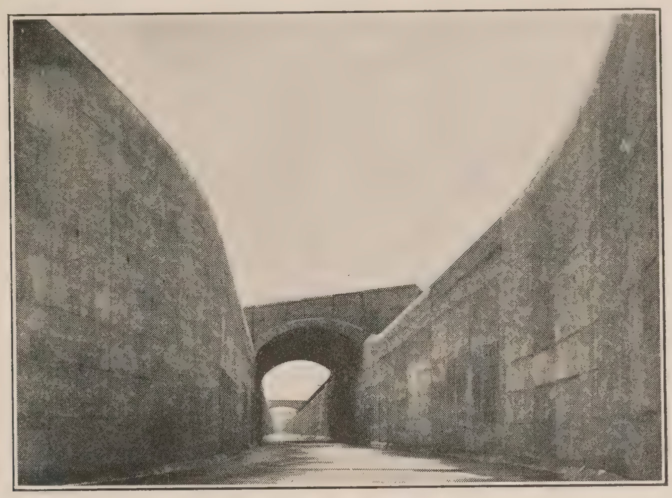
The slot on the upstream side of the tube varies in width from 1 ft. at the shore end to 4 ft. at the outer end. A restricted section, shaped somewhat like a bathtub, forms a mouthpiece for each tube, its function being to give the required initial impulse to the sucking slot.

The head at any point on the tube, causing flow through the slot, is the resultant of three components (a) the initial loss due to the primer, (b) the total of the induced losses due to the increments of angular flow through the slot, and (c) the total cumulative friction head in the tube, including velocity head.

The designed rate of total inflow through each slot is 2,500 cu. ft. per sec. along the axis of the tube. The rate of inflow per lineal foot of slot has not been chosen uniform, however, because the river feeds more water at the outer end of the tubes than nearer the shore. This variation has been chosen in the ratio of four at the outer end to three at the inner end of the slot, a factor which agrees with the natural flow distribution under present river conditions. The total loss of head in each gathering tube to the end of the diffuser, with a flow of 2,500 cu. ft. per sec. in each tube, will be only 0.3 ft.

Queenston-Chippawa Canal

For many miles above its mouth the Welland River is a sluggish stream, meandering slightly in a depression that can hardly be called a valley. This stream for 4½ miles forms the first reach of the canal, and its low banks provided a suitable disposal area for much of the material excavated in the process of straightening and deepening the channel. The radius of curvature of some of the bends is increased in the new alignment but the old channel location is largely followed. The velocity under full-load conditions will be low, being limited by the scouring velocity for the clay soil through which the improved channel is cut. Leaving the river channel near the crossing of the Michigan Central Railway the canal takes a course almost due north for over three miles. The earth overburden is quite heavy for the whole of this portion of the canal, the bottom grade of the earth section of the canal meeting the rock surface one mile from the Welland River. The maximum rock elevation is not coincident with the maximum earth surface elevation but the profiles of rock and earth surface are roughly parallel to each other. Just beyond Lundy's Lane the maximum bend in the canal occurs, having a deflection of 51 degrees, and, at intervals of a little over a mile each, there are two other bends of 27 and



Canal Section

31 degrees. The earth over-burden continues fairly uniformly for three miles beyond Lundy's Lane until Bowman's Ravine is reached.

Where the canal section again enters the rock cutting beyond the ravine, the earth over-burden becomes very light, in some places amounting to only a foot or so. Two deflections are made in the remaining two miles of the canal, one of 33 and the other of 47 degrees. A quarter mile beyond the second of these curves the forebay is reached.

Earth And Rock Sections.

Long continued investigations were made of available information on factors of roughness for large canals in earth and rock,—with and without concrete lining. One of the conclusions reached was that the "Kutter" formula should be used. The roughness factors used in the hydraulic studies were 0.035 for the river section and 0.012 for the concrete lined rock section.

Economy Studies.

The procedure in determining the economic proportions of the canal will briefly be outlined. It is essential that the canal carry the full quantity of water required under the lowest conditions of water level in the Niagara River. A series of tentative canals were designed, each of 48 ft. width and capable of carrying the required supply of water with uniform flow and on the assumption of low water in the Niagara River at Chippawa. The first of the series was of such a depth that the velocity would be 4 ft. per sec. and the designed slope of the bottom and water surface was the requisite slope for uniform flow, the others being designed for higher velocities. The width of 48 ft. above mentioned was determined after study of the excavating plant available.

The cost of each of these canals was calculated and a curve was plotted

showing the relation between low-water velocity and cost. From this curve the tangents were scaled for various low water velocities. For low velocity the canals will be deep and therefore costly. For very high velocities the canals will be shallow but the slope so steep that the cost will be greater than for moderate velocities. The canal of minimum cost, however, is not necessarily the most economical.

Enlargement will reduce the friction loss and consequently increase both the head and the power output at a cost which, up to a certain point, is both justifiable and economic. The determination of the economic size is based not on low water but on the mean water conditions. For each of the canals thus tentatively designed, the profile of the water surface corresponding with mean water level in the Niagara River is computed, thus determining the friction loss and the lost power at mean water stages. Tangents were scaled from a "lost power curve" plotted from these results and were divided into the tangents from the "lost power curves" for each low water velocity. The dividend in each case is the cost per horse-power of the power gain at the particular velocity to which the results respectively apply. These dividends are next plotted against low-water velocity, thereby developing an "economic curve" from which the economic velocity may be selected.

Control Works.

An electrically-operated roller sluice gate of 48 ft. clear span—the full width of the rock section—is located at station 97+00 which is near the beginning of the rock section. The use of two gates with a central pier was considered, but the single gate was found to be the more advantageous, as it provided an unobstructed waterway with a consequent reduction in friction losses. The gate, which is supported on steel towers with a concrete substructure, weighs about 100 tons, and is provided with two hoisting mechanisms and two counterweights. When the gate is at the top of its run it is high enough above the water surface in the canal to permit a tug to pass beneath.

Whirlpool Section.

Bowman's Ravine, situated west of the whirlpool, was crossed on a rock fill, the cross-section of the canal being changed from a rectangular section 48 ft. in width to a trapezoidal section with 10 ft. bottom width and side slopes of 1 on 1½. This cross-section was designed to give as great a cross sectional area as the rock section has at the extreme minimum water level. The whirlpool section is lined with reinforced concrete. In order to withstand the pressure of the back water when the canal is emptied, the lining is provided with vents of sufficient size to drain the fill as quickly as the water can be drawn down in the canal.

Concrete Lining.

Economic considerations prompted the lining of the canal with concrete. The height of the lining was fixed slightly lower than the profile of the water surface existing when the load conditions on the plant are at a maximum and the flow in the Niagara River is at a minimum. Thus, at all times, the lining will be protected by submergence against the action of frost. The thickness of the lining varies according to the rock over-

break but averages about 20 in., and where necessary, steel dowels are used to anchor the concrete lining to the rock.

Extreme smoothness of surface is not the only determining factor but precise alignment is also a most important element in the reduction of hydraulic losses. Great care was taken to obtain a smooth surface by the use of steel forms and for this purpose a positive and rigid method of form setting was devised. This insured almost perfect alignment. The results obtained were excellent, and it is expected that when opportunity offers to test the efficiency of the lined section of the waterway, an extremely low factor of roughness will be realized.

The Forebay.

The kinetic energy of the water at the end of the canal, and at the entrance to the forebay had to be considered. In the forebay the velocity of the water would be so greatly reduced as to make its velocity head negligible, and some means, therefore, would have to be found to regain the energy in the water as its velocity decreased. The same difficulty is experienced here as in any transition in which velocity is being reduced, namely that the stream lines tend to follow paths of their own course, unless the design is carefully studied and the angle of divergence properly fixed.

A great mass of experimental data on diverging tubes for air and water is available indicating that a 10° angle of flare is the most efficient. In order to confirm, for this particular case, the conclusions arrived at from other experiments, a model of the forebay was built in the Hydraulic Laboratory of the University of Toronto, and tested with nineteen transitions of various angles and lengths. The diffuser is a wedge-shaped structure 221 ft. long and 37 ft. wide at the downstream end. The sides are vertical, straight and smooth and extend 28 ft. above the bottom of the forebay. An opening 16 ft. by 20 ft. in the end wall assures about equal pressures on both sides of the walls.

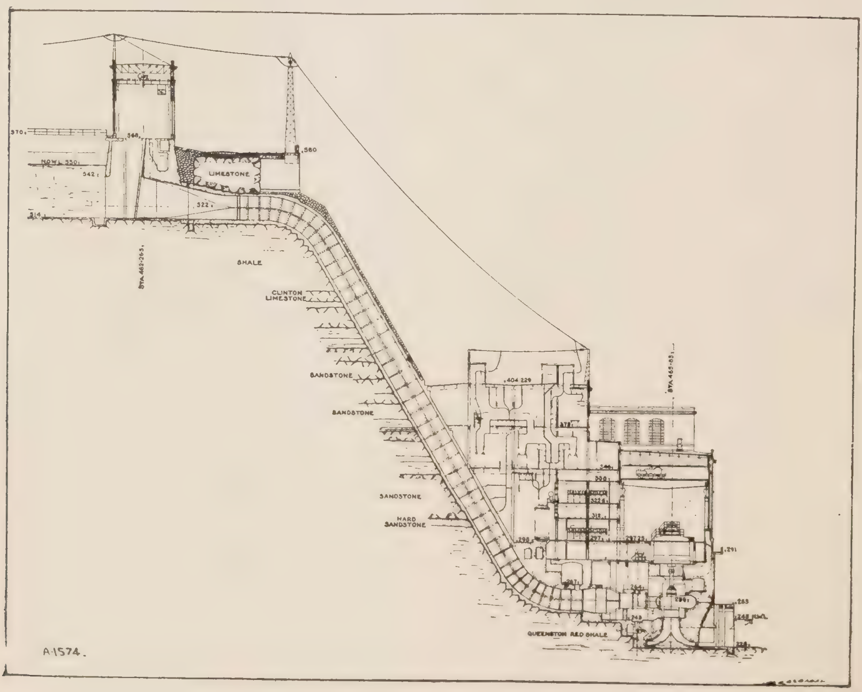
Through this diffuser expedient, the high velocity at the end of the canal is gradually reduced and its kinetic energy recovered, with the result that the elevation of the water in the forebay will be higher than at the mouth of the canal. For a flow of 15,000 cu. ft. per second, and mean water level at Chippawa, it is estimated that the reclaimed head will amount to approximately 1 foot. Observations made some months ago with a flow of 6,818 c.f.s. showed a water surface elevation at the screen house 0.21 of a foot higher than at the end of the canal.

Screen House.

At the lower end of the forebay, and serving as a dam for the same, is located the screen house. This structure forms the entrance, and the control, for the penstocks. The entrance to each of the main penstocks is a modified bell-mouth consisting of three openings 12 ft. 18 in. wide and 29 ft. high at the rack supports. These three openings gradually converge into one opening 16 ft. in diameter at the point of connection to the penstocks. In designing these water passages, particular care was given to the securing of smooth stream lines and consistent changes in velocity. The bell-mouth entrances are sealed by a concrete cur-

tain wall extending down to elevation 542.0 which gives a depth of 28 ft. above the floor of the forebay. Immediately behind the curtain wall, steel-lined gate checks are provided to support structural steel gates. These provide a means of unwatering in case it is necessary to inspect the lower sections of the racks, or the penstocks. The intake is divided into three waterways in order that the spans for the gates may be of convenient size and also to permit the use of racks of a somewhat new design. The racks, which consist of 3 by 3/8 in. bars on edge, 5 in. centres, are fastened rigidly to a structural steel supporting frame held in checks in the concrete walls. The whole of the rack structure is removable and is split horizontally into two sections for convenience in handling. A specially designed rack follower with an automatic latch arrangement is provided to facilitate the removal of the racks, the bottom section being a considerable distance below the floor of the screen house. The bars and the supporting structure of the racks are designed to withstand a head of 10 ft. with a stress of 20,000 lb. per sq. in. in the steel.

A trash trench of liberal dimensions extends across the bottom of the forebay immediately in front of the screen-house piers to collect any debris or foreign material which may travel along the bottom of the forebay. The piers dividing the main unit entrances are 6 ft. in thickness, while the two intermediate piers in each unit are 3 ft. thick. The main dividing piers are designed for full water pres-



Cross Section of Power House

sure on each side in order that any unit of the intake may be unwatered while the adjacent units are in operation. An opening in the main floor immediately behind the racks provides a means of disposal of trash into a trough, which empties into the ice chute.

The entrance to the service unit is similar to the main unit, except that it consists of one bay only, and the entrance to the penstock itself is a true bell-mouth instead of the sectionalized transitions in the main unit entrances. The ice chute bay has a clear width of 25 ft., and is provided with a roller type sluice gate, which is lowered to pass surface water carrying ice. After passing the gate, the water and ice enter a concrete pipe 10 ft. in diameter and pass down the cliff, out beneath the power house, into the Niagara River. Stop log checks are provided ahead of the gate for use in an emergency or for inspection purposes.

CONCRETE COVERED STEEL PENSTOCKS.

From the screen house, the water is carried to the turbines in steel penstocks. The first five main unit penstocks are 16 ft. in diameter for approximately two-thirds of their length, and are then reduced by a taper section to a diameter of 14 ft. The remaining penstocks are 16 ft. in diameter for their complete length. In the penstocks there are two bends, one located at the top and one at the bottom. These elbows are held in massive concrete anchor blocks, the one at the upper bend forming a foundation for the piers supporting the sidewalk and roadway extending along the edge of the escarpment.

The plates vary in thickness from one-half inch at the top section to 1¼ in. at the lower section. The longitudinal butt straps are ½ in. thick with two rows of ⅞ in. rivets for the lightest joint, and 15/16 in. thick with four rows of 1⅜ in. rivets for the heaviest. The efficiency of the longitudinal joints at the heavy section is about 85 per cent. In the erection of the penstock, a new departure was made by the use of electric rivet heaters.

The penstocks are covered throughout the entire length with a concrete envelope, having a minimum thickness of 24 in., which protection will increase the life of the steel pipes. The penstock for the service units follows the same alignment as the main penstocks and has a diameter of 5 ft. 6 in. As friction loss in this pipe was not such an important factor, lap joints and inside and outside courses were used.

The generating and transformer station is situated below the escarpment and close to the river's edge; the station extends about one-half the distance to the top of the escarpment. The structure required to house ten main units and the service equipment is 700 ft. long. The substructure is of massive concrete construction carried down to rock foundations. The superstructure consists of a structural steel frame work with reinforced concrete floors and roofs, and concrete, brick and tile walls and partitions.

The steel columns are spaced longitudinally 26 ft. and 24 ft. alternately, starting at the south end. The strength of the generator room steel was primarily determined by the necessity of providing cranes to handle the generator rotors which weigh about 300

tons each. The structural steel was so designed that it could be erected and the crane operated before the concrete walls were poured.

To guard against flooding, the walls are designed to resist water pressure up to elevation 300, which is 16 ft, above the base of the generators. No openings which might admit water from the river were permitted below this elevation.

In general, all plant services are provided in the southerly 75 ft. of the station. In this area are situated the sump pumps and motors, the air compressor, the service generators, transformers and switchboards, erection space, main station elevator, maintenance shops and stores, lubricating and insulating oil plants, battery rooms, a fully equipped hospital room, also kitchen and dining room and offices. The intention is to duplicate nearly all of these services in the extreme.

Hydraulic Turbine Installation.

Turbines have a capacity of from 55,000 to 65,000 brake horse-power under 305 ft. head. The draft tube on No. 1 unit is of the common curved type modified at the elbow, whereas each of the other units is equipped with a Moody spreading tube. In the design of these units care was taken to insure good lubrication for the gate stems and to assure that all wearing surfaces were well greased. The use of labyrinth seals on the runner rims reduces leakage to a minimum. It will be noted on the section that the top portions of the draft tubes are of cast iron and these are so arranged for units 1 to 5 that they can be lowered to facilitate the removal of the runner from below, thus dispensing with the necessity of the dismantling of the generator. Owing to the presence of a considerable amount of sand in the water during periods of flood, and by reason of dredging operations in the upper canal, a pressure sand filtering plant has been installed to filter all water supplied to the lignum-vitae bearings, in order to prevent scoring of the turbine shaft. The lignum-vitae bearings themselves are about 6 ft. long and in order to ensure lubrication over their entire length the water is admitted both at the middle and at the top of the bearing. A flow meter, with an indicator and an alarm light, is connected to the bearing water supply to guard against any stoppage of the flow continuing long enough to injure the shaft or bearing. The longitudinal passageway on elevation 264 gives access to the turbine bearings, gate stems, servomotors, governors and filters.

Air brakes, which act against the underside of the generator rotor, are provided to bring the unit quickly to rest in case of shutdown.

Gratifying results were obtained when the turbine and generator units were tested, two independent tests made on unit No. 5 agreeing with each other within a small fraction of one per cent. The outstanding items of interest in this connection are: a maximum overall efficiency of 91%, a maximum turbine efficiency of 93%, an output at the point of maximum discharge of 65,000 horse-power coincident with an efficiency of 85% and a range in turbine capacity from 30,000 horse-power to 63,500 horse-power with efficiencies above 90%.

Johnson Valve Details.

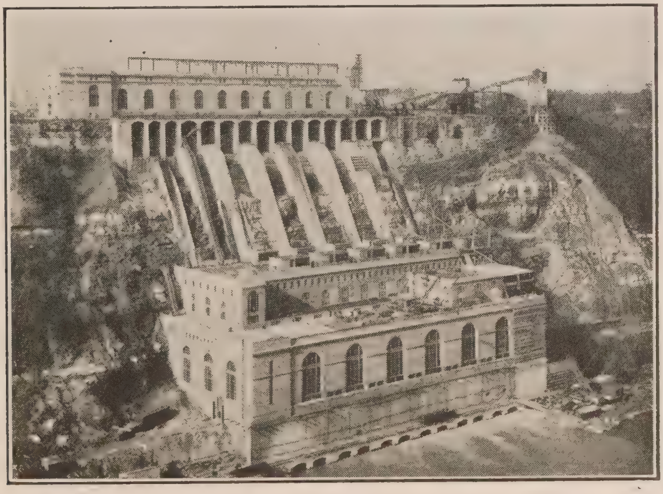
The lower end of the main penstock

terminates in a 14-ft. Johnson valve, the outlet end of which is 10 ft. in diameter and connects to the turbine casing by several sections of cast-steel pipe. Although this type of valve is too well-known to require any description, the method of control is worthy of note. Control is accomplished through three 8-in. Johnson valves, which are in turn operated by pistons in cylinders under penstock pressure controlled by a three-way plug valve. When opening the valve in order to fill the scroll case, it is necessary to build up the pressure in the latter so as to balance the pressure on the two sides of the plunger. The operation of the valve is so arranged that this is done automatically by a series of oscillations of the plunger, as soon as the control handle has been thrown into the opening position. In closing, the motion of the plunger is retarded near the end of the stroke to prevent an excess rise in pressure, due to too sudden closing, and also to protect the plunger seat against shock. The control is so arranged that the valve will close automatically in case of a break in the scroll case, and it is also provided with a remote hand control so that it may be closed, if necessary, from the control pedestal on the main operating floor.

The 5 ft. 6 in. service penstock terminates in a steel plate Y, the two legs of which are each equipped with a 36 in. Johnson valve for each service turbine.

Governor Systems.

The governor system for the main units uses filtered water containing a small percentage of bichromate of potash. This is supplied to the governor at from 150 to 200 lb. per sq. in. pressure from two motor-driven centrifugal pumps which feed into an accumulator tank for each unit. The return fluid from the servomotors is carried back through a return main to two concrete tanks so arranged that one tank may be emptied and cleaned while the other is in operation. It had



View from United States' Side Showing Power House, Penstocks and Screen House

been found in other installations, where a central pumping system capable of handling the completed plant was initially operated to supply only one or two units, that difficulty was experienced owing to the large capacity pumps heating up the small amount of fluid in circulation. To avoid this, a small capacity pump was also installed to supply governor pressure during the early stages of operation, and was afterwards to be held in reserve for an emergency. To guard against a shutdown due to the failure of the governor pumps, an emergency connection has been provided to pass direct penstock pressure into the governor system header. This permits the governors to operate on penstock pressure at any time that the pumping system is out of service and was called into service when the first two units were operating.

Owing to the small ratio of length of penstock to head (about 1¼:1) and the large flywheel effect of the generator rotors, the regulation of these units is a comparatively simple problem.

Details of Generators.

The present units are each rated at 45,000 kv-a., 80 per cent. power factor, 12,000 volts, three-phase, 25 cycles at 187.5 rev. per min. They are capable of being operated continuously at 49,500 kv-a., with either voltage or current 10 per cent. in excess of the rated values. The units are vertical with direct-connected shunt-field commutating-pole, 250 volt, 150 kw. exciter. The over-all efficiency of the generating units is slightly in excess of 97 per cent. at power factor of 80 per cent. The thrust bearing is designed to support a load of 1,000,000 lb., which is slightly in excess of the weight of the rotor plus the hydraulic thrust imposed by the turbine. Upper and lower guide bearings are provided, the latter on account of the length of shaft and in order to keep the generator a self-contained unit.

The quantity of air required for cooling is 120,000 cu. ft. per minute. It is interesting to note that the weight of air passing through the generator every 2½ hours equals the total weight of the generator, namely, 1,400,000 lb. The units are completely enclosed, the air being drawn either from the outside or the inside of the generator room, or from both, and discharged through ducts into the atmosphere or to the different sections of the building for heating purposes. With five units in operation at rated load, there will be available for heating the building 5,400 kw., which corresponds to 1.2 kw. per 1,000 cu. ft. of building contents. This should be ample for heating the building at all times.

Units 1, 2 and 3 are all of the same make, having a rotor with cast steel spider and laminated built-up sheet steel rim, dovetailed to the spider. These three units have upper and lower bearing brackets of cast iron, and are provided with the Kingsbury thrust bearing. Armature windings are insulated in slot portions with sheet mica insulation ironed on, whereas the end portions of the windings are insulated with mica and varnished cambric taping. The stator is divided vertically into four 90° sections.

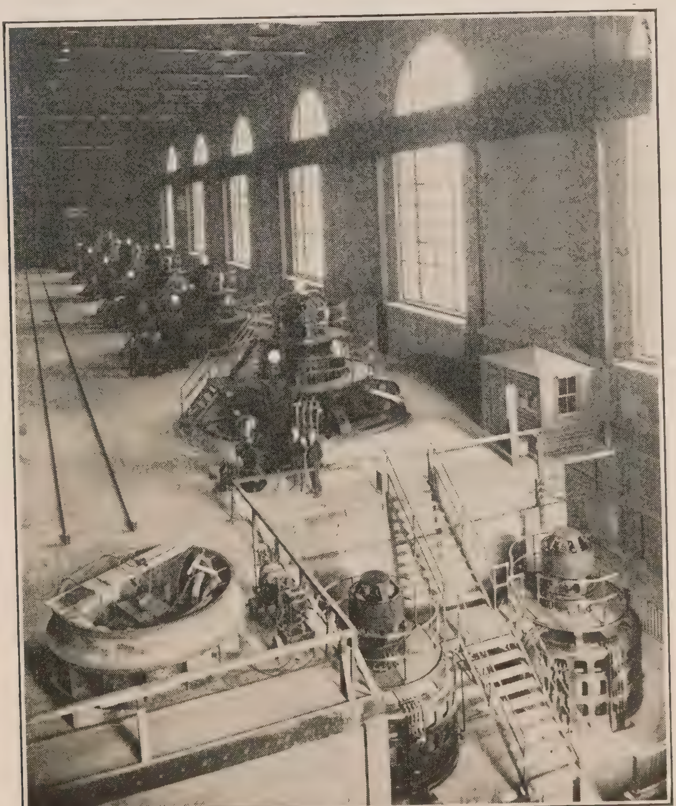
Units 4 and 5, being made by a different manufacturer, have a rotor made up of seven cast steel sections, five of

which carry the pole pieces. The other two,—one above and one below,—are provided for additional flywheel effect. Upper and lower brackets are of cast steel and a spring supported type of thrust bearing is used. The armature coils are insulated throughout with mica tape. The stator is divided into three 120° sections.

The flywheel effect of each unit is 21,500,000 WR^2. The rotors are required to stand an overspeed of 185 per cent. of rated speed. Insulation tests are specified of 30,000 volts on armature and of 2,500 volts on field and exciter.

The over-all diameter of these units is 25 ft., the diameter of rotor over pole faces being about 18 ft. The shafts are 30 in. in diameter in the guide bearings and are provided with flange at lower end for bolting to corresponding flange on turbine shaft. The shafts are hollow with 8 in. diameter bore and are 30 ft. 3 in. long. The over-all height of generators above the generator floor, (elevation 284) is 26 ft. 10 in. Thus above the main floor (elevation 297) only the top of the frame and the upper bracket, thrust bearing housing and exciter are visible.

The weight of the complete generator is 1,400,000 lb., that of the rotor



Interior of Power House

615,000 lb. The largest piece to be handled by the cranes weighs 600,000 lb.

As excavating methods have been described so frequently, only the salient features wherein the work differed materially from ordinary construction will be discussed.

Through the earth overburden, a trapezoidal section was excavated; this has slopes sufficient for stability after rip-rapping and a berm on each side was left at the bottom of the earth excavation sufficient to provide for loading-tracks. The rock was excavated sufficiently to provide a 48-ft. concrete-lined waterway.

An electrically-driven shovel with a 90 ft. boom and 58 ft. dipper stick capable of handling an 8 cu. yd. dipper was used. With few exceptions these units could work in earth excavation from the rock surface, loading on tracks on the top of the slope, thus exposing in one operation the whole side for rip-rapping.

The earliest designs of the rock section called for a channelled face from top to bottom. At a later date, however, this feature was revised and only the uppermost 10 ft. of rock excavation was channelled and this was done principally to preserve the integrity of the rock berms for the loading-tracks. Below the 10-ft. level the sides of the excavation were prepared for concrete by deep close drilling.

The handling of 12,000,000 cu. yd. of dry earth excavation and 5,000,000 cu. yd. of rock, together with 500,000 cu. yd. of concrete ingredients, other structural materials and plant, could hardly be conducted properly without a complete and efficient system of trackage. As a part of the earlier construction program, connections and transfers were arranged with the principal railway lines and storage and sorting yards established at central points. The main-line double-track railway was constructed parallel to the location of the canal from end to end and connected to the several yards. These tracks together with loading and service tracks and double-track lines to the various disposal areas made up a total of about 90 miles of single-track railway; all of which were of the best heavy construction and provided with overhead for electric operation.

The disposal of excavated materials was handled almost entirely by twenty-six, 55-ton electric locomotives, and a similar number of steam locomotives were in use for yard and service duties, and also for moving excavated materials as an adjunct to the electrical equipment. The standard spoil train was made up of eight 20-yard all steel side dump cars, equipped with compressed air apparatus for discharging.

Canal Lining Plants.

The sequence of operations in lining the canal was: First, the paving of a strip 15 ft. wide on each side of the floor; second, the construction of the side lining in alternate panels, 40 ft. in length; third, filling in of the intermediate panels of the lining; and fourth, the paving of the centre strip of the floor.

The outstanding problems to be solved in connection with the lining of the walls of the canal were the extreme heights to be concreted in a single operation; the disposal of seepage; the necessity of obtaining the

best results in regard to density, smoothness of finish and adhesion to the rock; and the great distance over which the operations extended.

By the end of 1920, two miles of the canal prism had been excavated to grade and made ready for concreting. The program for concreting the remaining distance of 5½ miles had to be adjusted to suit the operations of the five, high-lift shovels, which were working in separate openings and scheduled to finish simultaneously. It was necessary, therefore, to install more lining equipment than would have been required, for the sole purpose of completing the concrete work immediately after the shovels had finished the excavation. This program was carried out so that excavation was completed on November 30; concreting was finished on December 18, and water admitted to the canal on December 24, 1921.

From Nov. 1, 1920, to Dec. 17, 1921, 410,000 cu. yd. of concrete were placed, 379,000 cu. yd. of this being placed in 1921, while 332,000 cu. yd. of this latter quantity were placed from May to December, inclusive, or at an average rate of 41,500 cu. yd. per month. The record day's pour was 3,046 cu. yd. with 17 plants operating, the record week is, 18,278 cu. yd. and the record month is, 63,362 cu. yd.

The average amount of cement used per cubic yard of concrete of all classes on this work has been 1.28 bbl. of 350 lb. net weight, the Canadian standard barrel of cement. This is equivalent to 1.19 bbl. in American units. The averages for the different classes has been as in the tabulation below.

Approximately 235,000 cu. yd. of sand were purchased. Half of this was obtained from a pit accessible from the tracks of the Commission, and the rest from Lake Ontario. Both deposits contained materials of excellent quality.

Class	Minimum Compressive Strength at 28 days lb. per sq. in.	Barrels of Cement Per Cu. Yd. of Concrete Can. bbl.	U.S. bbl.
A	2,500	1.67	1.55
B	2,000	1.46	1.36
C	1,500	1.20	1.12
D	1,000	0.98	0.91

—*Canadian Engineer.*

Automatic Generating Stations Near Campbellford, Ontario—Central Ontario System

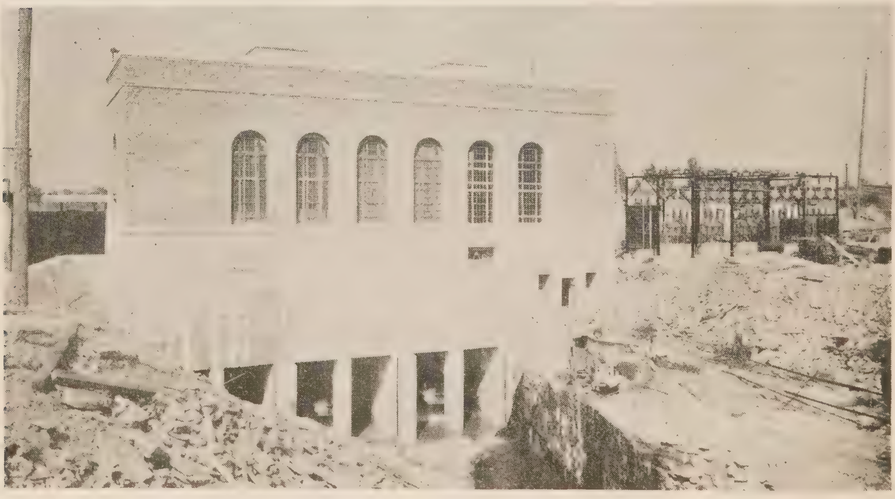
By C. F. Publow, Electrical Engineering and Laboratory Dept., H.E.P.C. of Ontario

THE Commission is at the present time developing the power sites at Dams No. 8 and No. 9 on the Trent Valley canal System. These are located respectively six and four miles down stream from Campbellford and are thus only a few miles from Ranney Falls, the new Generating Station on this system, which was placed in service in 1922. The development at Dam No. 8 is nearing completion, the first unit having been started up on September 13, and the second on September 16, 1924. The station at Dam No. 9 will be ready early in 1925.

An interesting feature of these two developments from the standpoint of engineering and operation as well as economics is the making of them automatic with remote supervisory control. This is the first installation of this character to be made by the Commission, the first in Canada for Hydraulic Generating Station; it is believed to be the largest combined development under automatic control on the continent, and its operation will doubtless be watched with interest.

Although the application in these instances of the supervisory control equipment has been made to new stations, it is possible to apply it to existing stations by supplying certain control features. In any application a detailed study of its pecularities will be required in order that suitable equipment may be chosen.

At each development there are three units, those at Dam No. 8 have their



Power House, Dam No. 8 Development

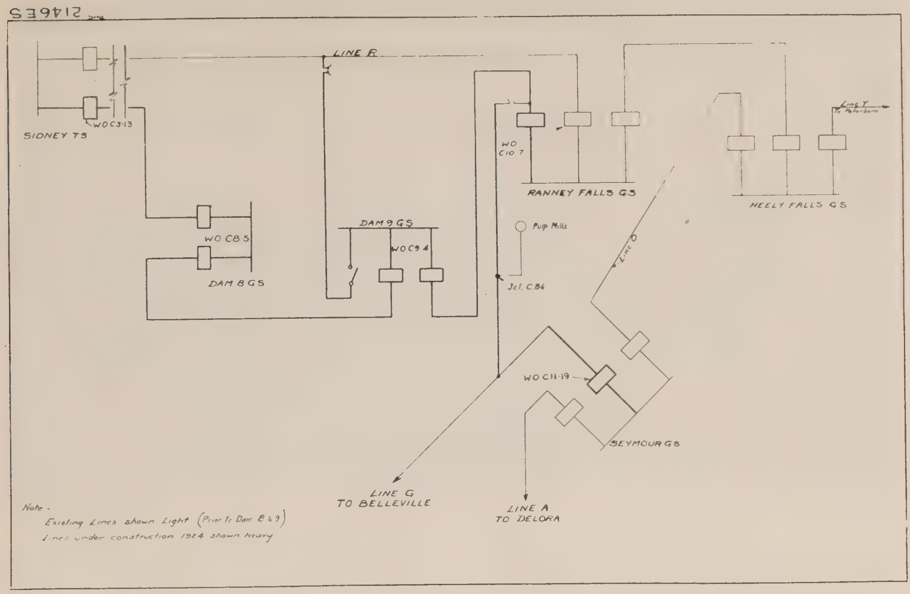


Diagram of Switching and Lines between Heely Falls and Sidney

turbines rated at 2,200 h.p. and generators at 2,000 kv-a. at 80 per cent. power factor, 6,600 volts, 3 phase, 60 cycle at 150 rev. per min.; those at Dam No. 9 have their turbines rated at 1,600 h.p. and the generators at 1,400 kv-a. at 80 per cent. power factor, 6,600 volts, 3 phase, 60 cycle at 180 rev. per min. At both stations the units are vertical with direct connected exciters.

The stations are both located alongside of the dams of the Trent Valley Canal System. The sub-structure of each station is of re-inforced concrete construction while the superstructure at Dam No. 8 is of native lime stone and that at Dam No. 9 of concrete. The superstructures house the generators only, the transformers and 44,000 volt switching equipment being placed outdoors with the steel structure.

The control for both stations will be located in Ranney Falls Generating Station. It will be possible for the operator at this point by pressing ordinary telephone switch keys to—

(1) Start and stop any unit in either plant.

(2) To increase or lower the load on any unit.

(3) To raise or lower the power factor of either station.

(4) To place either one or both stations on full automatic control, being controlled by a water level float which is located in the respective station, due to the fluctuation of the water level in the forebay.

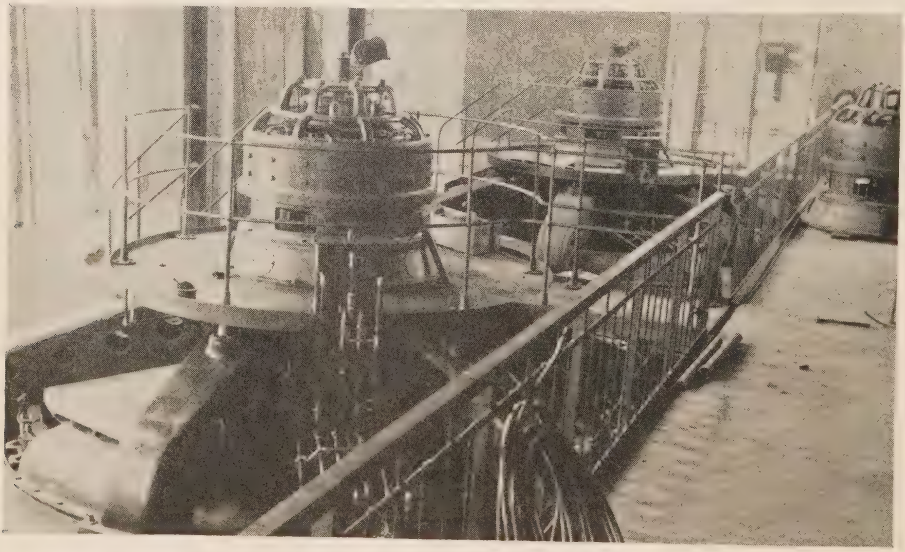
The metering equipment will be installed at Ranney Falls and will indicate the kilowatts and integrate the watthour load output of each station. Separate meters will indicate the reactive volt amperes carried, and graphic instruments will record the variations in water level in the forebay at each of these remote stations, and rows of ten

lights indicate the gate opening of each unit.

All these signals are transmitted similarly to the method used in automatic telephony and in event of any automatic functioning of the equipment at either of these stations the operator at Ranney Falls will immediately be warned of this operation by a Klaxon horn sounding, and should he be at the control board at the time he could actually note what operation has been performed automatically by the signal lamps changing on the board. Another Klaxon horn, located at the remote stations, is also energized for a short period to call the station attendant. Provision has been made in the equipment whereby the operator can check the position of all the equipment at either of the remote stations by pressing a special telephone key for this purpose, which will start a sequence of signals, which will entirely check the location of all breakers, the signal lamps at Ranney Falls either remaining as they were or changing if some operation had occurred and not been signalled through previously.

A unique feature at both stations is that any of the generators can, under normal control, be started and placed on the line and be carrying full load in less than one minute from the time the operator operates the key switch to start the unit, most of this time being taken in the machine speeding up.

Each generator on starting is brought up to approximately 95 per cent. full speed when the breaker is closed automatically placing the generator on the line without field excitation, the field switch is then immediately closed automatically and the generator pulls into step and is at once under governor control. The design of the generators, at Dam No. 8 having solid field poles and those at Dam No. 9 being equipped with a special pole face or amortisseur winding, gives



Generators Nos. 2 and 3, Dam No. 8 Development

Outdoor Structure, Dam No. 8 Development

them the necessary inherent high pull-in torque which permits this manner of operation. The governors on each unit are specially equipped with a bye-pass valve which, on starting, permits the gates to open a small way quickly and then allows them to continue opening very slowly. The governors are driven by synchronous motors rather than the former standard belt-drive.

Normally a unit is shut down by the governor closing to its no load full speed position when a contact is made which opens this unit breaker. By this method, the load formerly carried by the unit is gradually transferred to the other units which are operating on the system before it is cut clear of the line, thus avoiding surging. In cases of trouble, however, the unit is promptly cleared from the line by relays provided for that purpose. The brakes are automatically applied by a mechanical attachment on the governor, the governor oil pressure being used for the operation of the brakes.

The lubrication for each generator is self-contained. At Dam No. 8 the thrust bearing operates in an oil bath and is water-cooled, receiving water from the supply pipes to the turbines, by syphoning it through; the guide bearings are fed with oil from a gear driven pump located in the lower guide bearing pan. At Dam No. 9 the oil for each unit is cooled by a cooling coil located in the water supply pipes to the turbines, and the oil pump located in the lower guide bearing pan circulates the oil of each unit to all its bearings.

The turbines at both stations have been supplied by the Allis Chalmers Limited, the ones at Dam No. 8 being of the "Francis" type while those at Dam No. 9 are the "Propeller" type. Woodward governors are being installed at both stations. The generators at Dam No. 8 are being supplied by the Swedish General Electric Co., and those at Dam No. 9 by the Canadian

Westinghouse Company. The complete switching equipment for both stations is being supplied by the Canadian Westinghouse Company. The step-up transformers at Dam No. 8 were supplied by the Packard Electric Company while the service transformers at this station and all those at Dam No. 9 are supplied by the Moloney Electric Company.

Each generator and its step-up transformer is considered a unit, there being no low voltage oil switches; however by means of disconnecting switch and a transfer bus, it is possible to connect any generator with any transformer. Protection and control can also be interchanged by operating corresponding sets of knife switches in the protective devices and control circuits.

The output of both stations will be fed into the Central Ontario system on one of the circuits between Ranney Falls and Trenton. An emergency connection is provided from Dam No. 9 to the second circuit between Ranney Falls and Trenton.

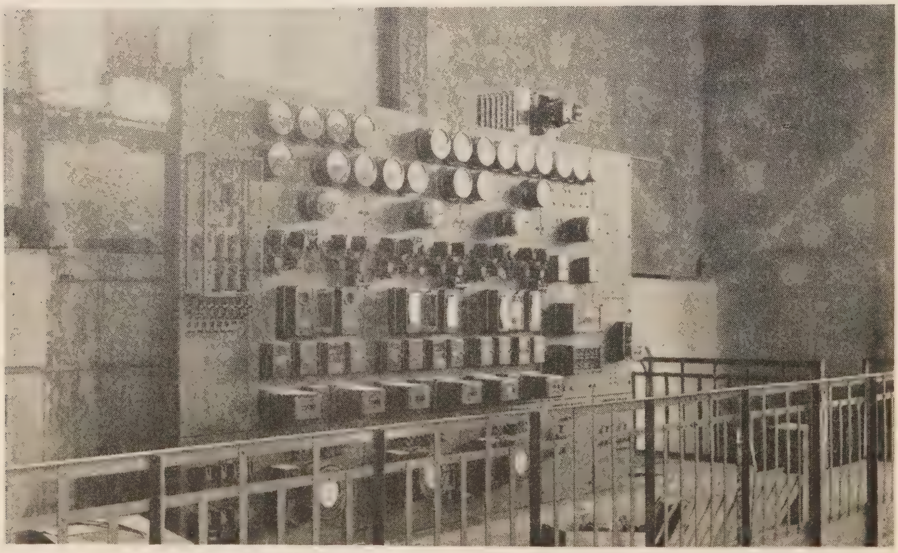
In addition to the customary protective devices which are installed by the Commission, each generator has the following:—

(a) Thermal relays, these function only if a pre-determined load on each unit is exceeded for a given length of time and they cause the unit to shut down only temporarily until they, and also the generator has cooled down.

(b) Thermostats on all bearings, when these function due to excessive heating they operate a lockout relay on the particular unit in trouble, immediately shutting it down and preventing the starting of the unit until the lockout has been reset by hand.

(c) An over generator voltage relay, this functions as (b).

(d) A field failure relay, this also functions as (b).



Station Control Board, Dam No. 8 Development

The step-up transformers are equipped with contact making thermometers which function like the thermostats on the generator bearings.

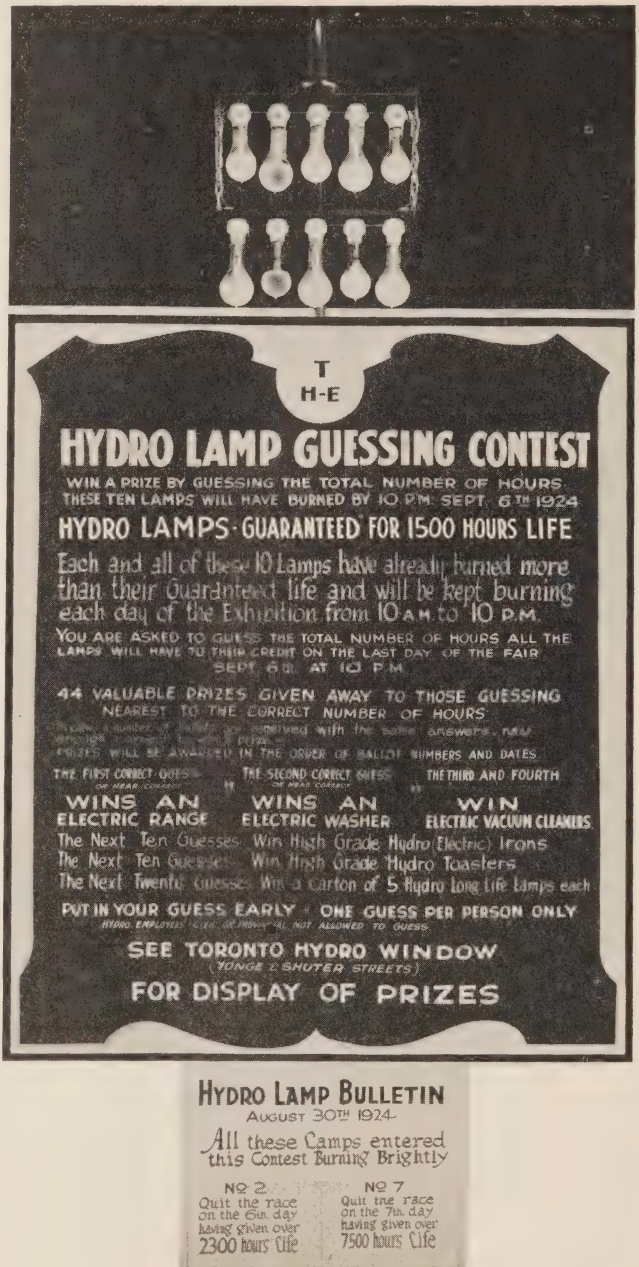
Each station is equipped with a switchboard on which is mounted the customary metering equipment, the contactors for the automatic control of the station and in addition to this the special equipment for remote indication. The indication and integration of the output of each station in kilowatts and watthours is accomplished by what is known as the "Impulse" method whereas the indication of the reactive volt amperes and the graphic record of the variations in the forebay water level is accomplished by the "Series" method of metering. The Switchboard is equipped with pushbuttons, which permit the station to be manually controlled in an automatic manner.

The supervisory control equipment, portions of which are installed at Ranney Falls and at each of the remote stations is similar to the automatic telephone system installed in the Commission's office building. Ten (10) wires are required between each remote station and Ranney Falls for the control and indications.

By the use of this control it is possible to reduce to a minimum the attendance at the remote stations. This further means a considerable saving in accommodation for the operator as the generating stations are located away from the town. This saving is partly off-set by the additional cost of the supervisory control and its maintenance and supervision.

Voltage regulators are being installed in each station which controls the voltage of the station rather than each unit. Special inter-locking devices have been provided whereby only one generator controls the regulator at any one time.

Use is being made of the present battery at Ranney Falls to provide 48 volts d.c. for operation of the supervisory control equipment at that point. At each of the remote stations a 48 volt battery is being installed, which has sufficient capacity for the operating of the 44,000 volt line oil switches and it is also used for operation of the automatic and supervisory control equipment located in these stations. The battery is charged from the exciters, interlocking equipment being provided so that only the exciter on the first unit started will do the charging. The battery charging equipment is controlled by a contact making ampere hour meter, which automatically controls the charge taken by the battery.


T
H-E
HYDRO LAMP GUESSING CONTEST
WIN A PRIZE BY GUESSING THE TOTAL NUMBER OF HOURS THESE TEN LAMPS WILL HAVE BURNED BY 10 P.M. SEPT. 6TH 1924
HYDRO LAMPS · GUARANTEED FOR 1500 HOURS LIFE
Each and all of these 10 Lamps have already burned more than their Guaranteed life and will be kept burning each day of the Exhibition from 10 A.M. to 10 P.M.
YOU ARE ASKED TO GUESS THE TOTAL NUMBER OF HOURS ALL THE LAMPS WILL HAVE TO THEIR CREDIT ON THE LAST DAY OF THE FAIR SEPT. 6th AT 10 P.M.
44 VALUABLE PRIZES GIVEN AWAY TO THOSE GUESSING NEAREST TO THE CORRECT NUMBER OF HOURS
NUMBERS AND DATES
THE FIRST CORRECT GUESS
WINS AN ELECTRIC RANGE
THE SECOND CORRECT GUESS
WINS AN ELECTRIC WASHER
THE THIRD AND FOURTH
WIN ELECTRIC VACUUM CLEANERS
The Next Ten Guesses Win High Grade Hydro (Electric) Irons
The Next Ten Guesses Win High Grade Hydro Toasters
The Next Twenty Guesses Win a Carton of 5 Hydro Long Life lamps each
PUT IN YOUR GUESS EARLY · ONE GUESS PER PERSON ONLY
SEE TORONTO HYDRO WINDOW
(YONGE & SHUTER STREETS)
FOR DISPLAY OF PRIZES
HYDRO LAMP BULLETIN
AUGUST 30TH 1924
All these Lamps entered this Contest Burning Brightly
No 2
Quit the race on the 6th day having given over 2300 hours Life
No 7
Quit the race on the 7th day having given over 7500 hours Life

HYDRO LAMPS

are *REAL* Long Life Lamps

On the opposite page is a reproduction of the display of 10 Hydro Lamps entered in the Hydro Lamp Life Guessing Contest, conducted at the Canadian National Exhibition, Aug. 23 to Sept. 6, 1924.

These lamps were picked at random out of many lamps which are continuously on life test at our laboratories and were exhibited to drive home to the thousands of Ontario Lamp buyers the value of the Hydro Lamp Long Life Guarantee.

At the end of the exhibition when the life of these lamps ceased as far as the Contest was concerned, the lives lived by these lamps were as follows:—

No.	1— 75	watt	3,976	hours	Still burning
No.	2—100	”	2,892	”	Burnt out
No.	3— 75	”	4,026	”	Still burning
No.	4—100	”	4,056	”	Still burning
No.	5— 75	”	2,616	”	Still burning
No.	6—100	’	3,606	”	Still burning
No.	7— 75	”	8,122	”	Burnt out
No.	8—100	”	3,496	”	Still burning
No.	9— 75	”	3,056	”	Still burning
No.	10—100	”	6,356	”	Still burning

Total burning hours 42,202
Average burning hours 4,220
With 8 lamps still at it.

Compare these figures with the guarantee of 1,500 hours.

Hydro Lamps are designed for Long Life—

Buy them and use them on your Street Lighting System.

Sell them to Hydro Customers who should have the best money can buy.

Hydro-Electric Power Commission of Ontario

This Label Is Your Guarantee

Courtesy

Contributed

A CERTAIN discussion at which I was present recently, gave me to think seriously, and ever since I have been wondering whether we, in the Province of Ontario, who have to do with the conduct of electrical utility enterprises, have not been so absorbed with the details of operating, and buying and selling, that we have unconsciously overlooked something even bigger.

In the first place, what is Courtesy, anyway? Many dictionaries define the word in many different ways, and we all know in the abstract what is involved, but do we think of Courtesy as a gift which we may bestow or withhold at will, or as a duty—an obligation which we owe, and must pay? I think that, whether we practice it or not, we all know that it is a duty. The French language contains a very gracious way of looking at the idea of duty. The same word is used as a noun meaning "duty" and as a verb meaning "to owe", so that a duty is a positive obligation or debt, and not an optional one,—to be repudiated at will. Why can't we transplant this idea into the English language? Surely the Anglo-Saxon stock is not too barren a soil to afford it space in which to take root and flourish. Let us say then that the practice of Courtesy is a debt that we owe to our fellowmen in just as positive a way as we may owe a debt of money.

There is nothing new in all this and it only leads up to what I have in mind. In competitive commercial enterprises the practice of Courtesy is a business asset, and is capitalized as such. The pressure of competition is strong enough to reward liberally those who carry Courtesy into all their business relationships, and to discredit or eliminate entirely those who do not. But in our Province the conduct of our business is, in the main, non-competitive. Maybe we feel that people must have electric light and power, and that they must come to us for it, and that it doesn't matter particularly just how we meet the public so long as we supply good service at reasonable rates. Maybe we don't feel that way, maybe we don't act that way, maybe we feel that as long as we are not actually discourteous we have done our duty.

Consider this: In a certain station of a large railway system there is a gateman of stern and forbidding aspect, who shows signs of intense annoyance when asked a question, who answers with a harsh voice and a supercilious air, whose truculent manner overawes the timid traveller in need of information. I have never heard this man actually insult a traveller by word of mouth, and so I suppose he is not discourteous, but is he courteous? In the same station there is another gateman whose smile and word of greeting are ready, who is quick to help and direct the timorous wayfarer or the stranger who is not familiar with the labyrinthian and evil-smelling catacombs where he presides. To pass this man at the commencement of a journey

is a pleasure; to pass the other man engenders homicidal mania. Does the good influence of the second man cancel the evil effect of the first man? It does not. Human nature is so constituted that the mind retains the recollection of a slight longer than the memory of a kindness. To many people that first gateman personifies the railway system that employs him, and his surly ways and repellant manner are larger liabilities than any corporation should care to carry.

Whom do you remember longer, the motorman who stopped his car so that you had to wade over your boot tops in very cold, very wet slush to reach the step, or the one whom you saw help a blind man into the car, and carefully seat him before proceeding?

Perhaps the other day your wife told you about how a meter reader from the gas company opened the kitchen door without knocking and demanded to know where the gas meter was. Did that help to develop a friendly feeling on your part toward the gas company? Did it make you feel that you would want to give the gas company a helping hand if it were in trouble? You know it didn't.

Now, to the public—that is to you and me that haughty gateman, that indifferent motorman and that ill-bred meter reader typify the railroad company, the transportation commission and the gas company. These very minor employees represent their employers, and when they treat us as we think we shouldn't be treated, our resentment is directed against those who employ them more than against them personally. Very well then; if you and I feel that way toward the railway company, the transportation commission or the gas company, what reason have we to believe that our customers don't feel the same way towards the Hydro when we or our employees don't treat them as courteously as they rightly consider their due?

To our customers, the employees of the Hydro with whom they come in contact typify the Hydro, and any discourtesy or any lack of courtesy on the part of our employees is held far more against the Hydro than against the offender himself—or herself.

Are any of our employees discourteous to our customers? Do any of them exhibit lack of courtesy? Is the lack of competition insidiously breeding a "don't care" spirit, a feeling that "we're here and you're there and what are you going to do about it"? Is it dulling the fine edge of our appreciation of the niceties of courteous transaction of our routine business affairs? I think that each of us can profit much by pausing occasionally to check up the degree of Courtesy which we extend to everyone —literally—with whom we come in contact.

Finally, may we not gain by the realization that Courtesy is not a negative affair consisting of abstention from the practice of downright discourtesy, but is a very fine, very gracious, very honourable payment of a debt that each one of us owes to every other one of us. One need not have a patent of nobility in order to be subject to the very fine old dictum — "noblesse oblige".

RE. ELECTRICITY INSPECTION ACT

In the March Issue of the Bulletin, a short article appeared, regarding the proposed revision of the Electricity Inspection Act. This Article was printed under a misunderstanding, as it was not our intention to make public any of the suggested changes in the Act, until same became law, and we have written Mr. Higman, Director of Electricity and Gas Inspection Service of the Department of Trade & Commerce, Ottawa, calling his attention to this Article.

* * *

SELLING SMILES

We hear and read everywhere to-day the word "sell", and it seems to have been given a new meaning. Ideas are "sold". A campaign is "sold". Whether it is "courtesy" or anything else, we speak of it in terms of selling and we mean by that,—"convincing".

But it has not been many years since those two words "sell" and "sold" had quite a different meaning. You remember "a sell". "I've been sold" meant, not the receiving of full value, but that you had been sold a gold brick.

The public remembers these words in their old meanings and it is suspicious. Your task is to educate them to the meaning you use them in to-day.

Courtesy is the great lubricant in human relations. You must use courtesy and you must use smiles to conquer the friction of suspicion. But your courtesy must not be alone the courtesy of affability. It must be from the heart; and a button won't give it to you, nor a mere smile, nor a campaign, nor a slogan.

Your smiles must not be mere smiles, your courtesy mere suavity. They must not be empty things. If you have something that is sincere, a service that is honest, then your courtesy has a real foundation.

Your campaigns are good. Your buttons and slogans bring you together as soldiers for a cause. You march shoulder to shoulder and the weaker is helped by the stronger. You regiment your purpose and when you meet the enemy, the sceptical public, you must face them with smiles which ring true to the heart.

No one in the electrical industry, it seems to me, should fear that his service to the public is unwanted, that there is no real demand for it. You are the forerunners of development and your great secret, electricity, is binding the world together, running the railways, lighting communities, is opening up lands, turning the wheels of industry. It is relieving everywhere the drudgery of mankind.

Let your smiles be smiles of friendship. Friendship, the friendship of the public through courtesy, elevates you.

To me, the life of every man is a tragedy, because I know from experience the struggles, the heartaches, the battles humanity fights. And if you come before me smiling through them all, you come before me radiant, for I can see your body is covered with scars, received in the struggle. So when you can smile, gentlemen, and exercise courtesy, you lift humanity up with you to a higher plane.

—*Journal of Electricity.*

OUR CONTACT WITH THE HOME

By Rose Gross.

Just as the stronger electrical force is applied by direct contact, so is the greater influence, be it good or bad, obtained by direct contact.

In so far as the home is concerned, the contact between the Central Station company and the consumer is 80 per cent. through the housewife. From the application for service to the paying of the bills, the greater part of the domestic business is carried on by the woman of the household. The same may be said of complaints. Eight cases out of every ten, it is the housewife who either phones, or calls at the office to bring the matter to the company's attention.

The home is the woman's workshop. Just as man is continually interested in the labor-saving devices for his office, so is the housewife forever looking for means of shortening her hours of work and eliminating unnecessary steps. And practically any appliance which the woman may consider, is something requiring electricity. Not even to mention the one essential of all work, life and happiness, *good light*, are all dependent upon electricity.

Since it is the woman whose needs must have electricity in the home, our next important step is to make our personal contact with the housewife agreeable. When a woman enters our office, bear in mind that she is not only one of our chief consumers of electricity, but she is also a prospective customer for much more current than she is now using.

The employee should look upon every contract with the consumer, as an opportunity to build up a better understanding between customer and the company. Frequently the dissatisfaction of the housewife does not reach us in the form of a complaint; but exists nevertheless—such dissatisfaction is of the most unfortunate kind, for it may grow and spread without the company having an opportunity to adjust or explain. It is here the cashier has an opportunity to be of great service to his company.

The employee in charge of the contract department has any amount of opportunities to establish good relations. It is here that the company's customers receive their introduction to the company. Their first impressions of the employees, their methods of doing business are gained here. Any little act of service will do much toward giving a favorable impression of the company to start with.

We must not overlook the telephone in our dealing with the public. Much of our business is transacted over the phone, and it is just as necessary that we are courteous in our phone conversations as it is in our personal meeting.

Above all, remember, that the building up and maintaining the proper relation between the consumer and the central company must be done through the home.

—"*The Southwestern.*"

Hydro News Items

Central Ontario System

A new steam turbine driven blower has been installed at the Oshawa Gas Plant as an auxiliary.

* * *

A new 1,500 G.P.M. motor driven pump is being installed at the Cobourg Water Works.

* * *

Owing to the increased demand for gas, a new holder of 300,000 cubic feet capacity will be erected at the Peterborough Gas Plant. The foundations are going in at present and it is expected that the erection of the steel will start about the middle of September.

* * *

Eugenia System

The second pipe line at the Eugenia development has been placed in operation, thus increasing the capacity of the Eugenia development by about 2,500 h.p.

* * *

The frequency changer set at Mount Forest, which is utilized for transferring power from the Niagara system to the Eugenia system has been rewound and placed in operation. It is expected that the assistance of this equipment together with the increased capacity at Eugenia on account of the second installation of pipe line, together with the purchase of power from the Orillia development at Swift Rapids, will enable the Commission to carry on for the coming winter and meet all demands on the Georgian Bay System until such time as the additional equipment now being installed at the Muskoka development and South Falls will be available and placed in operation.

* * *

The following changes in station transformers has been made recently on the Eugenia System on account of increased demands in various municipalities:—

The three 100 kv-a. transformers formerly in use in the Chesley sub-station have been removed to the sub-station supplying the Walkerton Quarry. The three 150 kv-a. transformers in the Walkerton Quarry have been placed in the Chesley sub-station, thus increasing the capacity of the latter by 150 kv-a.

The three 50 kv-a. transformers formerly at Shelburne sub-station have been removed and installed at the Holyrood station which supplies the municipalities of Lucknow and Ripley, and the three 100 kv-a. transformers at the Holyrood station have been installed at the Shelburne sub-station.

The Commission has been enabled to make these changes due to the fact that the loads at the Holyrood

and Walkerton Quarry stations have not reached the anticipated demands, whereas the loads at Shelburne and Chesley have considerably exceeded the expected demands in both these municipalities. Thus, the demands at Chesley and Shelburne have been provided for without the necessity of having to purchase new equipment, thereby effecting maximum economy.

* * *

Muskoka System

The work in connection with the installation of two 2,000 h.p. units at the South Falls Plant of the Muskoka system is progressing favorably, and it is expected that one of these units will be in operation before the close of the present year. The transmission line tying the Severn to the Muskoka System between Waubaushene and South Falls plant has been practically completed and will be available for use this Fall if found necessary.

* * *

Niagara System

The service to rural consumers in the district adjacent to the City of Welland, recently taken over from the Welland Electric Company, has been changed from 25 to 60 cycles. The system of the Company taken over by the Welland Hydro-Electric System will be completely changed over from 60 to 25 cycles within the next few weeks.

* * *

The London Public Utilities Commission are making arrangements to connect their various sub-stations with 13,200 volt underground cable system.

* * *

Work will shortly be commenced in connection with the high tension line from Oil Springs to Sarnia. This line will be constructed to operate at 110,000 volts, but for a time will be operated at 26,000 volts in parallel with the present lines. This line will supply the new sub-station being erected in the southern part of the City of Sarnia.

* * *

Nipissing System

The new Bingham Chute plant recently constructed by the Commission has been completed and placed in operation. Both turbines in the original Nipissing plant have been overhauled and the capacity of the plant increased thereby from 1,200 h.p. to approximately 2,400 h.p. It is expected that the new pipe line which has been constructed at the Nipissing plant will also be placed in operation during the early part of October.

* * *

Ottawa System

An extension of the Nepean Rural District is now being made to serve the Village of Manotick and a number of farmers in the vicinity. This extention will serve 35 new consumers and furnish street lighting in Manotick.

* * *

Rideau System

A serious fire occurred in Kemptville and injured part of the town's distribution system.

The Municipality of Smiths Falls is considering plans for an improved system of street lighting.

* * *

Severn System

The following station changes have been made on the Severn System—

A new 150 kv-a. 3-phase transformer has been purchased and installed at the Bradford sub-station to take care of increased power load in that municipality, replacing a 75 kv-a. unit originally in use.

* * *

A 150 kv-a. transformer has been purchased and installed at the Beeton sub-station to provide for increased demands in that municipality, replacing a 75 kv-a. unit originally in use.

* * *

St. Lawrence System

The Village of Finch has requested that a transmission line be erected to supply lighting consumers in the village. Estimates are being prepared on the cost of power to this Municipality, from the Chesterville Sub-station.

* * *

Residents of St. Andrews, Cornwall Township, have asked for estimates on cost of rural service. This hamlet would be supplied from the Martintown Sub-station.

Not long ago a lady purchased a small home motor from a distant mail order house, who not knowing what current the light company furnished, shipped a 25 cycle motor. When she received her so-called bargain she found it would not function. Calling the trouble department, she was informed the company only furnished 60 cycles, whereupon she wrote the following letter to the mail order house.

"Dear Sirs:

"The motor you sent me only had 25 cycles. The company here says I must have 60. Please send the other 35 cycles by parcel post so I can use your motor." —*Trumbull Cheer.*

List of Electrical Material, Devices and Fittings

Approved by The Hydro-Electric Power Commission of Ontario in August 1924.

Appliances

Canadian General Electric Company, Ltd., Hotpoint Works Division, Stratford, Ont.

Electric Flat Iron, "Sovereign," Cat. No. F.6.

* * *

The Appliance Manufacturing Company, Hartford, Conn.

Curling Iron, "Curlex," Cat. No. 48.

* * *

The D. Moore Company Limited, Hamilton, Ont.

Electric Cooking Ranges.

Cabinet Series, "Niagara," Cat. No. 194.

Low Oven Series, "Lachine," "Transcona," "Cascade" and "Chippawa," Cat. Nos. 32, 43, 154, 164, 263, 264, 501 and 502.

"Sunfire" Air Heaters, Portable Type, Cat. No. 20; stationary type, Cat. No. 22.

* * *

Gem Mfg. Co., Inc., Suite 403, Stevens Bldg., Detroit, Mich.

Electric Table Stoves, "Radio" and "Grand".

* * *

Rohne Electric Company, 2434 Twenty-fifth Ave., S., Minneapolis, Minn.

Water Heater "Sta-Warm".

* * *

Apex Electrical Manufacturing Co., Limited, 102 Atlantic Ave., Toronto.

Vacuum Cleaners, "Rotarex".

The Gurney Foundry Company, Limited, 500 King St., W., Toronto, Ont.

Cabinet Type Range, "Coelectric".

* * *

Kelvinator Corporation, 2051 West Fort St., Detroit, Mich.

Electric Refrigerator, "Kelvinator".

* * *

Capital Electric Appliances Limited, 148 Glen Avenue, Ottawa, Ont.

Portable Electric Cooker.

* * *

The McClary Manufacturing Co., London, Ont.

Electric Range, Type H.D.

* * *

Williams Tool Corporation of Canada, Limited, Brantford, Ont.

Electric Pipe Threader.

* * *

Wonder Recharger Corporation, Limited, 2964, Danforth Ave., Toronto,

Rectifier, "Wonder Recharger".

* * *

Fansteel Products Company, Inc., North Chicago, Ill.

Rectifier, "Balkite".

* * *

The Sunlight Electrical Mfg. Co., Warren, Ohio.

Portable Motors.

* * *

*Standard Computing Scale Co., of Canada, Ltd., Windsor, Ont.

Electric Scales. (As listed on card of July 8, 1924.)

*Metal Ware Corp., 3819 N. Ashland Ave., Chicago, Ill.

Percolator, Cat. No. S-56.
Toaster, Cat. No. S-59.
Waffle Iron, Cat. No. S-75.
Flat Iron, Cat. No. S-51-B. "Empire".

* * *

Fittings

Smith & Stone, Limited, Georgetown, Ont.
Receptacles for Attachment Plugs and Plugs.
Single Flush Receptacle, Cat. No. 1105A.

* * *

Jefferson Glass Company, Ltd., 388 Carlaw Ave., Toronto.
Shade Holder, "J. G. Co."

* * *

W. C. Hunt, 82 Melrose Ave., Toronto.
Wire Connectors, "Jiffy".

* * *

*Groundulet Co., 86 Park Place, Newark, N.J.
Ground Clamps (as listed on Underwriters' Laboratories card dated January 8, 1924.)

* * *

Switches

Ferguson Pailin Ltd., 311 King St. E., Toronto.
Knife Switches.
Oil-Break Switches, "F.P."

* * *

*Trumbull Electric Mfg. Co., The, Plainville, Conn.
Panelboards, Types C, P, CK, PK, CT and PT.

* * *

*The Arthur S. Leitch Company, Limited, (Submittor), 1001 Kent Bldg., Toronto.

* * *

General Electric Co., Ft. Wayne Works, (Mfr), Fort Wayne, Ind.
Automatic Switches, Types CR-2927-D1, CR-2927-D2.

* * *

Fixtures

The Florentine Co. Limited, 252-254 King St., E., Toronto.
Portable Electric Lamps, "Florentine".

* * *

Miscellaneous

*National Metal Molding Co., Fulton Bldg., Pittsburgh, Pa.
Elbows for Rigid Conduit.

* * *

*Northern Electric Co., Ltd., 121 Shearer St., Montreal, Que.
Asbestos-covered Wire.

* * *

*Radio Receptor Co., Inc., 59 Bank St., New York., N.Y.
Lightning Arrester, "Anchor".

* * *

*These devices are under the Underwriters' Laboratories re-examination or label service.

* * *

THE
BULLETIN

Published by
HYDRO-ELECTRIC POWER COMMISSION
of Ontario

190 University Avenue
Toronto

Subscription Price $2.00
Per Year

The Generation of Hydro-Electric Power in Canada

The Progress in Canadian Practice in Connection with Hydraulic Power Development

By H. G. Acres, Hydro-Electric Power Commission of Ontario

Extracts from Paper presented at the World Power Conference

INTRODUCTORY.

IN common with all other countries possessing potential water power resources, the nature, extent and utility of Canadian water power is primarily the outgrowth of the purely climatic factors of temperature and precipitation, associated, necessarily, with the topographical frame-work of the North American Continent.

Extending as it does from the Atlantic to the Pacific Ocean, and from the temperate zone to beyond the Arctic Circle, Canada embraces all phases of the temperature factor except the tropical and sub-tropical. As regards precipitation, also, the range of variation is great, with an approximate average of 60 to 80 inches per annum on the Pacific Coast, 40 to 55 inches on the Atlantic Coast, 25 to 35 inches in Central Canada, to as low as 20 to 25 in. on the Mid-Western Plains. Governed by the third factor of the continental topography, Canada has turbulent rivers heading in the high peaks of the RockyMountains; huge rivers flowing off the immense central table-land of the Mid-West and the Great Lakes Basin; and Eastward to the Atlantic Coast, a multitude of waterways, large and small, draining the slopes of the Laurentian Hills, and maintained and regulated by countless lake expansions, many of which have areas ranging from 50 to 1,000 square miles.

It is not within the scope of this discussion to enlarge upon the incentive toward water power development which has existed in Canada by reason of a growing industrial demand and a great variety of natural commodity resources, but granting that such incentive has been, and still is, in existence, it is evident from the general specification above outlined, that Canada must of necessity possess water power resources so great in magnitude and so

CONTENTS

Vol. XI. No. 10

OCTOBER, 1924

diverse in type, as to afford the widest possible scope for engineering accomplishment and initiative, in the matter of their proper and efficient development and utilization. Furthermore, the development and utilization of Canada's water power resources has been in progress for a great many years, and it would probably be irrelevant to, and certainly far beyond the reasonable limits of this discussion, to enter into any extended and more or less historical review of the progress of such development in its co-related engineering and industrial phases. It would seem expedient, therefore, to assume a date at which hydro-electric power development, in a modern sense, had its inception in Canada, and from that point to trace the general progress of the art up to the present time, stressing only those phases of the evolutionary process, as governed by primary natural limitations and requirements, which have given Canadian practice a more or less distinct identity. "Canadian practice" might of course be more appropriately called "American practice", as the progress of the art in Canada and the United States has been in a large measure contemporaneous, due to the similarity of the primary conditions governing its evolution.

The history of modern Canadian hydro-electric practice may be said to have had its genesis in 1905 when three vertical turbines of Swiss design and manufacture, were placed in operation at Niagara Falls. These units were of 10,000 h.p. capacity each, and were the largest ever installed up to that time. Following closely on this event, there was installed at Shawinigan Falls a 10,000 h.p. horizontal turbine of American design and manufacture; then again at Niagara Falls a group of 10,000 h.p. horizontal turbines of German design and manufacture; and shortly thereafter at the same point a group of 12,000 h.p. vertical turbines, designed and built in the United States. The then outstanding characteristic of these turbines was their great power, and since that time the element of "size" has furnished the main keynote for Canadian advancement in hydro-electric power production, in respect of such features as differ from contemporaneous practice elsewhere.

It is not to be inferred from the above statement that hydro-electric development, as an art would not have progressed in Canada, or elsewhere, but for the large increase in unit power capacity which was inaugurated at Niagara and Shawinigan eighteen years ago. The point is, that, as the direct producer of the saleable commo-

dity, the turbine became the focal point from which radiated all essential considerations bearing on electrical and structural design, to the end that the turbine might perform its vital function of revenue production with a maximum of efficiency. The natural reaction to this condition was to throw into conspicuous relief the shortcomings and imperfections of the turbine mechanism itself, and to force engineering thought into channels leading not only to the refinement and simplification of then existing standards of design, but to the creation of mechanisms having inherently new and improved characteristics. These improvements and innovations having therefore been devised, from time to time, to keep pace with the special need arising out of heavy investment in large turbines, it was a simple matter, in most cases, to apply these improvements down, as well as up, in the scale of unit turbine capacity, so that Canadian turbine practice, as a whole, received ultimately the benefit of an advance in the art which originally grew from the demand for turbines of larger unit capacity than had originally been called for elsewhere.

The maximum of hydraulic efficiency is realized when the passage of water, from the point of initial intake to the final point of disposal in the tail-race, is accomplished with a minimum of turbulence and distortion. This provision may or may not result in a maximum of unit cost efficiency, and between these two limits lies a world of compromise which precludes any possibility of fixing the precise meaning of "efficiency" by definition. Efficiency, in the broadest sense, results from the proper co-ordination of simplicity and strength in all hydraulic design.

Simplicity in design is of primary importance. The laws of nature function changelessly and with immutable precision by reason, mainly, of their simplicity, and in no branch of engineering is conformity and obedience to the laws and forces of nature a more vital element of design than in power plant construction.

Strength involves all features of design having to do with the stability and security of structures against the action of the elements, more particularly fire and water, and also shares with simplicity the responsibility for the dependable, precise and unfailing operation of valves, turbines, governors and other mechanical apparatus.

The above generalizations are fundamental, and all the important elements of hydraulic design should conform to them to the greatest possible degree.

It is the intention, if possible, to fix the present status of Canadian practice from this viewpoint.

Features of Present Day Practice.

Under this head will be considered various features of Canadian hydroelectric practice, many of which have actually originated in Canada, and do not yet appear to be known, or to have found general acceptance among European designers and builders.

These features fall for the most part under the following headings:—

(1) Waterway Entrance Structures.
(2) Open Waterways.
(3) Long Pipe-Lines.
(4) Forebay Structures.
(5) Penstocks.
(6) Penstock Valves.
(7) Governors.

(8) Draft-tubes.
(9) Turbines.
(10) Generators.

In the introductory chapter it was stated that Canada's progress in the hydro-electric art was primarily attributable to certain underlying natural conditions, coupled with a rapidly growing industrial and domestic demand for power. These factors besides necessitating the development of the "super-turbine" as previously mentioned, also laid upon the power producing corporations a similarly growing obligation to improve service efficiency. One of the outstanding necessities in connection with this latter requirement is to hold the full plant rating, continuously available under winter operating conditions. By reason of this fact Canadian practice has attained a certain individuality through the study of the ice problem, as related to successful hydro-electric plant operation under temperatures frequently ranging as low as 40 to 45 degrees (Fahrenheit) below zero.

Dams.

Canadian conditions up to the present time have not given rise to any outstanding features in connection with dam construction, but in the matter of sluice control, Canadian practice has evidenced a decided reluctance toward the adoption of rolling dams, automatic gates and apparatus of a similar nature which appears to be popular in Europe. Where slow regulation only is required, Canadian practice inclines very largely to the use of the simple stop-gate or stop-log, handled by a mechanically or electrically operated winch. Where frequent and rapid changes in flow conditions are involved, counter-weighted gates of the Stoney type have an almost universal vogue. In other words, Canadian practice, in this regard, mainly from consideration of winter operating conditions, has leaned toward simplicity and strength, rather than to complexity of design and precise mechanical functioning.

Waterway Entrance Structures.

This term is used to identify structures located at the initial source of water supply for any hydraulic plant fed through an open canal, pressure tunnel or pressure conduit, and is intended to distinguish such structures from the ordinary forebay and intake structures which are common to all power developments.

In Canadian practice the one controlling factor associated with the design and operation of entrance structures is the protection of the inner system of waterways, whether they be open canals, tunnels or pipe-lines, against the entrance of ice, and, in a secondary degree, of other floating material.

To the above end, the primary general requisite of design for all entrance structures is the fending off of floating matter by an adequate submergence of the entrance passages, coupled with an entrance velocity sufficiently low, not only to prevent vortices, but to be at all times less than the buoyancy impulse of the floating material. The attainment of this objective involves the solution of a complex problem of velocity and draft distribution.

Where the initial source of water supply has an appreciable velocity of its own, any approximation of uniform velocity distribution in the diverted flow through the water passages of the

ordinary type of entrance structure is impossible, and any design based on the attainment of such uniformity must inevitably fail. In every such case it will be found that while the average effective velocity of entrance may be within the designed limits, there will be regions where the actual velocity is so greatly in excess of the assumed average that the structure cannot function according to design, for the two-fold reason that the excessive local velocities destroy the efficacy of the submergence of the entrance passages, and because the resulting turbulence induces hydraulic losses greatly in excess of those calculated from the designed velocity of entrance.

Open Waterways.

The discussion under this head is to be limited to open waterways, because Canadian practice at the present time offers no distinctive features, from the structural standpoint, in connection with pressure tunnels, and also because the higher and purely hydraulic characteristics of closed pressure conduits will be discussed later under the head of long pipe-lines.

While the fundamental consideration bearing on the design of an open waterway, of any considerable length, is an economic balance between capital cost and the annual value of lost power, each constitutes a unique problem in itself by reason of the many purely local factors involved, such as right-of-way values, alignment and topography.

In Canadian practice, however, particularly in cases where the system load requires that full plant rating be continuously and instantaneously available, one outstanding factor enters into the consideration of all open waterway design; namely, the maintenance, under extreme low temperature conditions, of a delivery of water sufficient at all times to carry the revenue producing capacity of the turbines up to the limit of their rating. In the general case a waterway which meets this specification embraces the other elements of efficiency, because the general equation of capital investment against the value of lost power will have been satisfied.

It is therefore necessary to consider the effect of the ice problem on another important element of hydraulic design. In this case, however, the discussion turns mainly on stationary ice cover, rather than ice in motion, because, with the assumption of an adequately designed entrance structure, the problem of moving ice becomes of minor importance, being limited to the comparatively small quantity originating within the area of the waterway itself.

The formation of ice on a waterway of the type under discussion is influenced by variable combinations of air temperature, water temperature, wind, and the relationship which exists, for any fixed volume of flow, between marginal and mid-section velocities. The latter factor is more or less a controllable one, inherent in the design, the others being of climatic origin and therefore uncontrollable.

When ice formation on such a waterway is an accomplished fact, the subsequent occurrence of ice trouble is governed primarily by the degree of uniformity of mean velocity, and the relationship between width and depth for any fixed area of wetted section.

Where water flows in a regular channel with an appreciable velocity, ice formation always originates in the low velocity portions of the cross-section near the shores. Having secured the shore line for an abutment, this marginal ice builds out, bridge-like, from both shores towards the centre of the stream, the rate of progress being mainly governed by the climatic factors above mentioned. While these marginal ice sheets build outward, they also thicken, and if the climatic factors are such as to cause them to meet in the middle of the stream, the under surface of the sheet is roughly parabolic in form, having a minimum thickness at mid-stream, and a maximum thickness at the haunches abutting the shores.

In climates where there are sustained periods of low temperature, as in many parts of Canada, a complete ice cover may be formed in this way and persist for considerable periods, but if the temperature rises sufficiently, the ice sheet at mid-section disappears through the joint action of temperature and erosion, and open water will show. This trend of open water will widen out, or get narrower, or close altogether, in harmony with the variation in the climatic factors. Meanwhile, the haunch ice holds intact and tends to gradually thicken through the agency of ordinary frost action, and also by reason of accretions of slush and frazil which adhere to the lower surface of the ice sheet, as a result of the low transportivity of the shoreward current filaments.

It is therefore evident that in a waterway where the width is great in proportion to the depth, and where the side slopes are flat, the tendency to encourage ice formation is a maximum.

As above mentioned, another primary requisite in reducing the ice hazard in an open waterway is to keep the water flowing, throughout its length, at as uniform a velocity and with as little disturbance in the gradient and alignment of the current filaments, as possible. This means that all sudden natural expansions and contractions of the cross-section should be obviated to the greatest extent practicable, and that such obstructions to flow and interruptions in gradient as are caused by bridge piers, regulating sluices, drop weirs, etc., should be reduced to a minimum.

The above precautions will not only tend to reduce the thickness of sheet ice cover, but will fulfill the far more important function of reducing the liability of frazil and anchor ice formation at critical temperatures, as the turbulence induced by such structures will cause frazil to form in amounts which will be dependent upon the length and frequency of periods of critical temperature, and which might, during some winter seasons, be frequent enough, and of sufficient duration, to form a hanging dam under the solid ice sheet, of such extent as to seriously restrict the effective discharge section.

Assuming that the theory upon which the above conclusions are based is reasonably sound, it follows that the most efficient cross-section for an open waterway should have such a maximum of depth, and minimum of width, as is consistent with the character of the overburden and underlying solid material through which the water-

way is to be excavated. This conclusion is furthermore reinforced by two other considerations which are usually involved, the first being that considerable heat is retained in the larger and deeper body of water which usually constitutes the source of initial supply, and this heat will be retained longer in the waterway itself if the section is narrow and deep instead of wide and shallow; the second consideration is that in a wide, shallow section, there is danger of the temperature of the bottom material being at times lower than the water which flows over it, thus offering encouragement to the formation of anchor-ice. On the other hand, if the waterway is deep enough, a converse condition obtains, whereby the underlying strata will always be warmer than the flowing water, and its ice resisting properties will derive the additional benefit of convection, and variation in density.

Therefore, as regards the type of waterway under discussion, it would appear, from the standpoint of the ice hazard, that the primary factors influencing the design should be:—

(a) To provide as uniform a surface gradient from intake to forebay as topographical conditions will permit.

(b) To make the depth of the waterway as great in proportion to its width as the natural slope and scouring propensities of the overburden and underlying solid material, if any, will allow.

More particularly where the channel of the waterway is in earth and the range of permissible velocities thereby limited, an additional manifestation of ice trouble must frequently be considered in the design, having to do with the effect of weekly load-factor on ice cover.

If a power plant, fed through an open waterway, ordinarily operates during the working days of the week under fairly uniform loading, a sustained period of extreme low temperature may cause solid ice cover to form throughout the length of the waterway transforming it for the time being into a closed conduit subject to surge pressure.

If the above period of uniform plant loading terminates with a more or less sudden week-end shut-down, the induced surge pressures will rupture the ice sheet, and spurting water will flood the surface of the ice and saturate any snow which may have fallen or drifted in, in the meantime. Subsequent to this occurrence, if the extreme weather continues, and the shut-down covers a period of, say, 36 hours, this surface water and slush will have time to freeze solid and become part of the original ice sheet, having nearly the same specific gravity. Consequently, when load is again pulled on, this thickened ice sheet will fall with the surface gradient and further contract the effective discharge area by an amount roughly corresponding to the increment of thickening. Furthermore, in a wide, shallow section the sheet will adhere to the shores and sag in the middle, and if it takes a freezing set in this position it forms an inverted arch which will greatly intensify the surge pressure, and flooding action, during the next ensuing shut-down period. In a deep, rectangular section the sag factor does not enter into the problem, because the ice sheet shears vertically at the shore lines, and rises and falls

bodily with the surface gradient.

It might be assumed from the above description that the sagging ice sheet on a wide, shallow section could alternately flood and freeze until the water supply was shut off completely. This cannot happen where there is any reasonable volume of flow, because there is always a critical point, governed by fortuitous combinations of air and water temperature, at which the tendency of the sheet to thicken is counteracted by the erosive action of the free water, which increases with its velocity, and scours away the lower surface of the ice sheet. This action is necessarily much more rapid and pronounced in a deep, narrow section than in a wide, shallow one, because in the former instance the marginal, as well as the mid-section velocities, are high, and also because the water temperature is usually higher, as previously explained.

Another interesting feature of recent Canadian practice in connection with open waterways has to do with the design of bends. The theory of this design is more conjectural than mathematically precise, and is briefly to this effect; (a) that the loss induced by the deflection of the stream-lines will be a minimum if the agency producing the disturbance, namely, the curve itself, is made as short as possible, and (b) that the turbulence induced by the change in direction of flow will be reduced and more or less localized if extra lateral space is provided at the seat of disturbance, so that whirls and eddies may be quickly dissipated, instead of being forced forward into the straight section of the waterway. The first requirement is met simply by making the radius of the curve as short as possible, and the second by making the curve equiradial.

Other features of Canadian practice under this head, including such problems as the fixing of economic mean velocity, bottom slope, and surface gradient for non-uniform flow, would require a detailed mathematical analysis for intelligent demonstration, and are therefore not suspectible of the descriptive and general method of treatment adopted throughout this discussion.

Long-Pipe Lines.

Where the development of power involves the use of a closed pressure conduit of any considerable length, certain phenomena become manifest which frequently constitute a serious menace to safe and practicable operation. The continuous rejection and pulling on of load increments, under such a condition, causes recurrent surges throughout the length of the conduit, which, if not damped out or relieved, will sometimes multiply and become super-imposed to such an extent as to cause pressures very greatly in excess of that due to the static head. This condition, in conjunction with the conversion of static pressure into velocity head for acceleration purposes, when a large increment of load is pulled on, will impose a duty in the governors which they are not designed to perform, and where long closed conduits are connected to overgate turbines, which is a far from unusual occurrence, an aggravated condition may obtain which is entirely beyond the regulating range of the governor.

Here, also, it happens that the advent of the "super-turbine" was the

primary cause of bringing the above described phenomena into prominence in connection with modern hydraulic design. The reason for this was that the continuously increasing amounts of water to be handled gave rise to serious problems of pipe design, having to do primarily with the heavy capital cost involved in the construction of pipelines of constantly increasing diameter, while at the same time adhering to the then accepted limits of feasible peak-draft velocity. This condition naturally led to an intensive study of flow phenomena in closed conduits, the progress of the art under this head being marked by the use of primitive vent-pipe, the more modern stand-pipe, the bursting plate, and various mechanical devices, all aimed at the one possible means of solution; namely the extending of the limit of feasible peak-draft velocity.

The discussion hereunder has to do with the controlling elements of this problem, and a description of the means of its final solution.

The power-discharge curve for the ordinary turbine will show a maximum production per second-foot at the point of best efficiency, and the first differential of this curve will show a rapidly decreasing rate of production per second-foot from that point to full gate. Consequently, every horse-power pulled on in excess of best efficiency capacity will require a rapidly increasing amount of water to produce it. If, therefore, the turbine is operating at or beyond the point of maximum efficiency, when the system demands a large increment of load, there will be a falling off in power production per unit of water supplied, and coincident therewith, a loss of effective head, due to the absorption of such velocity head as is necessary to accelerate the water-column. During the period when the water-column is accelerating, it is therefore evident that a condition might obtain where the power output is actually falling off while the water input is increasing, the result being that the governor may open the gates full-stroke in response to the falling speed, at which point its controlling function will cease, until either the fly-wheel effect of the system holds the unit, with dropping frequency, for the space necessary for the governor to gradually resume control on rising speed, or until the generator drops the load and the turbine jumps to runaway speed at full gate, with possible disastrous consequences.

Insofar as the control of surge pressure is concerned, it is evident that if no practical limitations be placed upon it, in the matter of diameter and height, the ordinary stand-pipe would be an ideal corrective agency. It is clear, however, that in the case of a large capacity high head installation, unrestricted scope in design is wholly impracticable from the standpoint of both cost and space limitation. On the other hand, a simple stand-pipe, designed and located within reasonable cost and space limitations, may at times actually make more acute the conditions it is designed to correct or alleviate. This is due to the fact that the simple stand-pipe can only passively absorb surge pressure, with its recurrent phases, and for this reason often acts as an agency for superimposing, one upon the other, pressure waves generated by successive changes

in load.

Another obvious expedient under this head is to limit the range of velocity change in the conduit by means of a synchronous relief-valve or by-pass, actuated by the governor mechanism. Such a contrivance can be adjusted to prevent the occurrence of disruptive pressures in the conduit, and also to supplement the influence of the system fly-wheel effect, in holding the unit within the regulating range of the governor when the unit is pulling on or rejecting load, but only by reason of the fact that the condition under discussion has not necessarily to do with the maximum conduit velocity at any one time, but with the *range of change* in conduit velocity over a short period of time, and with the absorption and building up of head energy induced by these changes, within their low and high limits.

The synchronous by-pass or relief-valve therefore has a useful function, but in the case of a large high head installation, its usefulness would be largely discounted by its cumbersome dimensions, its waste of water, and an added mechanical complexity which should be avoided whenever possible as a matter of principle.

The discussion under this head has now reached a stage where it is possible to define the specifications of an ideal surge control agency:—

(a) It should have the effectiveness of a simple stand-pipe of very large dimensions, without its cost and space requirements.

(b) It should be capable on the one hand of preventing, or counteracting the effect of, any undue absorption of head energy when load is pulled on, and on the other hand, of preventing or counteracting the effect of, any serious recurrent surge pressures arising from load rejections, whether isolated or successive.

(c) The water surface should be sufficiently active to prevent freezing in ordinary low temperatures, and dimensions should be such as to allow feasible and effective frost protection against extraordinary low temperatures.

(d) It should operate without wasting water.

(e) It should be mechanically simple with a minimum of moving parts and adjustments.

(f) It should be entirely dissociated from the governor mechanism, leaving the governor free to perform its own peculiar and highly important function, which is to control the speed of the generator, and not the vagaries of the water-column.

This specification has been met with a large degree of effectiveness by the Johnson differential surge-tank, one of the most wholly original and useful contrivances recently developed in the field of hydraulic engineering.

It has been above stated that the incentive which initiated the development of modern pipe-line engineering in Canada was the necessity of extending the limit of feasible peak-draft velocity. This problem, in the first place, involved a realization of the fact that if the old standards of design were adhered to, pipe-line and stand-pipe construction would soon reach a dimensional limit which would be fixed almost wholly by cost considerations. Furthermore, where large modern tur-

bines are connected to long pipe-lines, the element of mass becomes a major factor in design, as related to the effect of the inertia and momentum of a heavily energized water-column on speed control.

As the two factors, inertia and momentum, are a direct function of velocity, length of pipe, and gross head, it follows that there are possible combinations of these factors, especially if they involve a very low ratio of gross head to length of pipe, where the older methods of design may be entirely inadequate even at prohibitive cost. The unique feature of the differential surge-tank lies not in the fact that it can merely improve and cheapen conditions, which might be met by other means, with an adequate degree of effectiveness, but that it can insure efficient speed control even under the extreme conditions above mentioned. The reason for this will now be explained, after first briefly describing the main structural features.

The structural features of the differential surge-tank are extremely simple and consist of three essential elements; namely, an ordinary tank of diameter and height varying with the conditions to be met; a simple stand-pipe, or "riser", having about the same diameter as, and connected direct to, the pressure conduit, and also, projecting through the bottom of the tank to a height definitely fixed by design; and finally, one or more "ports" or openings, precisely located and proportioned, forming a water connection between the internal riser and the bottom of the surrounding tank.

In the case of an ordinary simple tank, the taking on of an additional increment of load will cause the contents of the tank to fall bodily through a distance which measures the head necessary to accelerate the water-column and meet the demand of the turbines for more water. Conversely, following a rejection of load, the water-column in the simple tank moves bodily upward through a distance which measures the balancing conversion of active energy or velocity head, into potential energy or static head.

The characteristic accompaniment of this cycle of operations is the assumption of a pendulum-like oscillation, synchronous with the period of the pipe-line, and controlled, so far as the inherent capabilities of the simple tank are concerned, solely by friction. It is evident, therefore, that the simple tank has one attribute only which can be utilized for the flow control of a long pipe-line; namely, storage capacity, which in turn is a function of diameter and height, and therefore of capital cost. On the other hand, the differential surge-tank possesses an additional characteristic, distinct from storage capacity, which enables it to function with very much greater effectiveness than a simple tank of similar dimensions or equal cost.

In order to concisely and clearly describe the principle of operation of the differential surge-tank the following hypothetical cycle of plant operation will be assumed:—

(a) Turbines operating on constant gate-opening, with resultant balanced conditions in the system.

(b) A sudden demand for a large increment of power.

(c) Reversion to balanced conditions, after the above demand has been

met and maintained.

(d) A sudden rejection of load.

Under condition (a) the respective levels in riser and outer tank must necessarily be the same, with no characteristic different from a simple tank.

Under condition (b) there occurs an immediate and rapid drop in the riser water level to an elevation below the hydraulic gradient corresponding to the then existing conduit velocity, thus almost instantaneously communicating to the main conduit the velocity acceleration impulse required for the delivery of an additional supply of water. Coincident with this action in the riser, but at a different and much slower rate, there occurs a drop in the level of the water in the outer tank, which naturally results from the passage of water through the ports into the riser, under the impulse of the lower water level therein. The outer tank therefore has the two-fold function of supplying stored water during the speeding up interval in the main conduit, and of helping to maintain the head on the wheels while the riser water-column is furnishing a maximum of accelerating impulse to the velocity in the main conduit.

Under condition (c) balanced conditions are again assumed, with riser and tank levels equalized at the new hydraulic gradient.

Under condition (d) there conversely occurs an immediate and rapid upward surge in the riser water-column to an elevation above the hydraulic gradient corresponding to the then existing conduit velocity, thus immediately communicating a decelerating and damping impulse to the conduit water velocity and to the induced surge pressure. At the same time there occurs a flow from the riser through the ports, to storage in the outer tank, which is necessarily governed in rate and quantity by the difference in levels. This joint functioning on the part of the riser and tank continues until the levels finally equalize on the new running gradient.

The above description of operating regimen should serve to make clear the differential action from which this type of tank takes its name; that is, the function of the active and sensitive water-column in the riser in imparting an appropriate accelerating or decelerating impulse to the conduit water-column, as differentiated from the separate but simultaneous function of the outer tank in making good any short period deficiency in water supply on the one hand, or in storing rejected water on the other. The separating of these two functions, by means of flow back and forth through the ports, has the further effect of destroying the synchronism between the conduit and tank water-columns. Its effectiveness in this connection is so marked that the most extreme and dangerous operating condition possible, where a simple tank is used, cannot obtain; namely, a condition of synchronism between successive load changes on the turbines and the harmonic period of the pipe-line.

The crucial factor of design, in order that the differential surge-tank may have the characteristics above described, is to fix the area of the ports, and the proportions of the outer tank, so that, upon a change of load, the new elevation immediately assumed by the riser water-column shall be main-

tained throughout the entire period of change in velocity of conduit flow, while at the same time the rate of depletion or replenishment of tank storage, as the case may be, shall be such that the equalization of tank and riser levels will coincide with the resumption of a stable running gradient in the conduit system.

Contrary to the case of the simple tank, the above principle of design is susceptible of such exact mathematical analysis that predicted performance is usually realized in operation within a margin of two per cent. maximum error in any part of the cycle, so that, if required, the differential tank may be designed for "dead-beat" action. In the majority of cases, however, this characteristic is not of sufficient importance to justify the extra cost involved, but where the pipe-line is very long and the velocity and friction gradient high, the non-synchronous functioning of this type of tank nevertheless makes it possible, well within the cost limits of a simple tank of adequate dimensions, to design for the "dead-beat" or absolutely non-oscillatory condition, where the range of variation in tank levels is never beyond either the maximum or minimum running gradients of the conduit system, as governed by the characteristics of the connected load.

The initial consideration involved in the design of one of these tanks is the range of load change over which it is intended to function. This in turn involves primary consideration of the nature and characteristics of the system load, but in a scarcely less important degree, the co-related factors of length of unregulated pipe-line, and the fly-wheel effect, whether inherent or externally applied, of the machine installation. There is wide scope for experienced judgment in this connection, and though quite possible, it is not usual to design the tank for perfect functioning under the full range of emergency or accidental load variation, but rather for a range in the neighborhood of 40 to 60 per cent. of full load pulled on instantaneously, but making it safe, at the same time, for full load rejected. This latter condition is made possible by the fact that the only abnormal result of a full load rejection is the over-flowing of the internal riser, which spills into the outer tank. The volume and impact of this overflow furthermore acts as a direct deterrent to the conduit surge and thus reduces the amount of water required to be obsorbed by tank storage.

Forebay Structures.

The general problem under this head is to a large extent analogous with that of entrance structures, in that it primarily involves the adequate protection of the penstock intakes from entrance of, or obstruction by, ice and other floating material, and also because the gravity of the problem is proportional to the percentage of flow diverted from the initial source of supply. The fact also that the forebay structures, which are assumed to include the racks, constitute the last line of defense before the water enters the wheels, adds materially to their importance from the standpoint of design.

Whether the distance from the forebay to the initial source of water supply be long or short, it is nearly always necessary to reduce the velocity in the feeding waterway before it passes

through the racks, thus introducing at once the problems of enlargement loss and draft distribution. Unless the velocity in the feeding waterway is very low, the above conditions manifest themselves in the form of reverse currents and eddies along the margins of the enlargement, because the momentum of the entering stream has a tendency to keep the flow in straight lines instead of diverging with the cross-section, and frequently also tends to form localized vortices in front of the racks or curtain-walls, through defective draft distribution. Besides dissipating otherwise convertible energy, the above conditions have the far more serious effect, previously mentioned, of forming areas where floating material, including ice, will be trapped, or where suction will overcome its buoyancy impulse, and draw it into the racks or penstocks before it can be harmlessly disposed of through ice—weirs or chutes.

The primary considerations in gate-house design are, first, the fixing of sill elevations so as to make surface draft a minimum and to permit a properly proportioned and symmetrical acceleration of intake velocity for the full range of forebay gradients; and second, to completely house in the racks and provide such a curtain-wall seal as will insure frost protection to the above-water portions of the rack structure, and at the same time protect the penstock openings from surface ice and other floating material.

Penstocks.

Nothing of an outstanding nature has developed in Canadian practice under this head, the various types of plate steel, wood stave, reinforced concrete, lock-bar and welded steel penstocks being installed more or less in harmony with the governing factors of static head, length, gradient, size of installation, and climatic conditions. The influence of these factors, in their various combinations, upon the design and type of installation does not require to be enlarged upon at any length for the reason mentioned at the outset.

When extreme low temperature is a factor it is common practice to house in or bury the penstocks, or to use wood stave pipe, where the other factors permit, on account of its cold resistant properties. As an alternative to the very doubtful expedient of burying steel pipe, the better method of encasing it in concrete is often employed, and where the distance is short from head-gate to turbine, solid concrete alone is used with the joint object of frost protection and permanence.

(*Continued in November Number*)

Comparative Water Power Development in Canada and the United States

Developed Power in the United States.

PRESENT Rate of Progress. In the last two or three years there has been great activity in applications for licenses under the Federal Water Power Act of June 10th., 1920. An interim report to November 1st., 1923, shows 317 active applications, totalling 12,700,000 h.p. available 90 per cent. of the time, and an estimated ultimate installation of 22,270,000 h.p.*. It also states that the developments now *under actual construction* under licenses from the Commission involve a proposed ultimate installation of 2,399,000 h.p.

The above implies very large and rapid development. An analysis † of this 2,399,000 h.p. shows, however, that 186,000 h.p. was scheduled to be put in operation in 1923, 261,000 in 1924, and 142,000 in 1925—a total of 589,000 h.p. in three years. It appears, therefore, that actual construction under the Federal Power Commission's licenses in not proceeding at quite so rapid a rate as would appear at first sight.

There are also many developments under construction which come under the jurisdiction of the individual States and not, or not entirely, under that of the Federal Power Commission. No official information concerning these is available, but information almost equally reliable is contained in the compilations made by the *Electrical World*.

A recent detailed table ‡ of such developments *actually under construction* in January, 1924, and specified as additional to those licensed by the Federal Power Commission, shows 77 plants, totalling 2,045,000 h.p. This is initial h.p., the ultimate being shown separately when available. The table shows every evidence of being prepared with care and reliability.

Installed H.P.—The latest complete official figure is that for 1921, 9,243,000 h.p.§. The *Electrical World* of January 6th., 1923, placed it at 9,540,000 h.p.

Power of January 1st., 1924, gives particulars of plants of 10,000 h.p. or over which were completed or nearly completed during 1923; these total 831,700 h.p., and adding 10 per cent. for smaller plants, the figure becomes 915,000 h.p. It is believed that, adding this to the *Electrical World's* above quoted estimate of 9,540,000 h.p., will give a conservative estimate of the total. The *installed h.p.* at January, 1924, is therefore estimated at 10,455,000 h.p.

Under construction, January 1st., 1924, and to be completed in, say, two years, as detailed above:—

**Electrical World,* January 5th., 1924, Page 27.

†Ibid, Page 28.

‡Ibid, Page 29.

§World Atlas of Commercial Geology. Part II. Water Power of the World.

Federal Power Commission licenses	403,000 h.p.
Other undertakings, initial h.p.	2,045,000 h.p.
Total	2,448,000 h.p.

Developed Power in Canada.

At January 1st., 1924, the installed turbine h.p. in Canada was 3,227,414* and there was under construction, and expected to be installed in two years, 900,000 h.p.†

Comparison of United States and Canada.

To compare on a per capita basis, the population as at January 1st., 1924, has been estimated on exactly the same basis for both countries—the figure of the last census plus the average annual increase during the past decade for the intervening years.

*Report No. 722, Page 1.

†Report No. 712, Page 1.

TABLE NO. 1.—CHRONOLOGICAL COMPARISON.

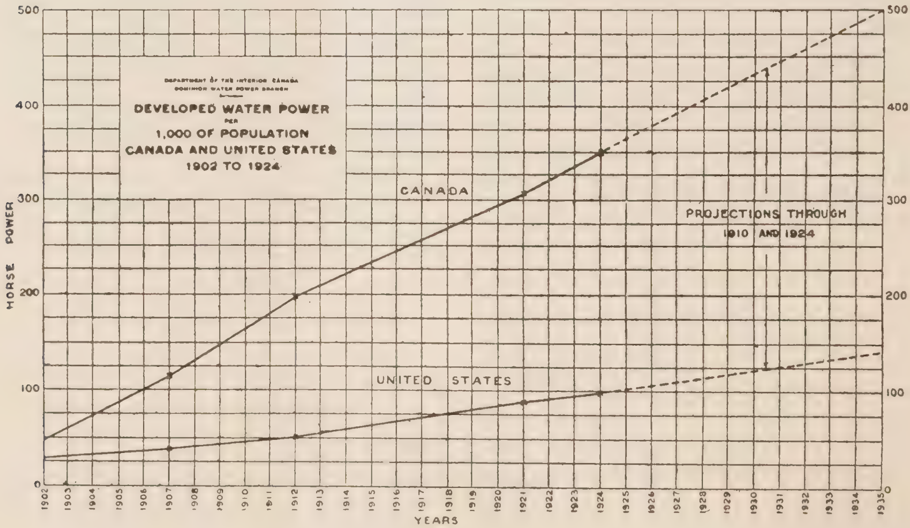
	UNITED STATES			CANADA		
	Population	H. P. Installed		Population	H.P. Installed	
		Total	Per. 1,000		Total	Per. 1,000
1912		4,870,320[c]	51.0[a]	7,343,000[b]	1,450,000	198
1921	107,085,000	9,243,000[d]	86.3	8,788,000	2,680,000	305
1924	109,832,000	10,455,000	95.0	9,184,000	3,227,000	350

[a]Electric Power Development in the United States. Senate Document 316, Page 26.

[b]Canada Year Book 1919, Page 491.

[c]Senate Document 316, Page 23.

[d]Water Power of the World. Washington, 1921.



Chronological Comparison of Water-Power Development.

The situation which the above table, No. 1, establishes is much more readily grasped from the accompanying diagram, and from the latter it will be seen that in water power development per capita Canada has up to the present time steadily increased her lead.

This, however, is not remarkable when it is remembered that cheap and abundant coal is available in the principal manufacturing areas of the U.S., and that the consumption of coal per kw-hr. in large plants has decreased during the last 20 years from 12 or 15 lb. to 2 or 3 lb., or even less.

Turbine H.P. Installed, January 1st., 1924.

	United States	Canada	Canada Greater by
1. Installed	10,455,000	3,227,414	
Per 1,000 of population	95	350	268%
2. Under construction	2,448,000	900,000	
Per 1,000 of population	23	98	326%
3. Totals of 1 and 2	12,903,000	4,127,414	
Per 1,000 of population	118	449	280%

WATER POWER v. FUEL POWER IN THE UNITED STATES.

In the competition between water and fuel power in the United States water power does not yet appear to be making any progress, though the large amount of hydro-electric development now taking place in the Western States may change the situation in the future. The proportion of output of central stations furnished by water power was, in 1919, 37.5 per cent., and in 1923, 35.1 per cent.

Additions and extensions by central stations during the last three years are as follows:—

CONCLUSIONS:

While the figures published by the technical and other Press of impending hydro-electric developments in the United States are imposing in their magnitude, it does not appear that, considered in relation to a population now about 110,000,000, and using about 60,000,000 h.p. (not including steam railroads), they are in any way abnormal, nor that they will cause any great change in the near future in the lead Canada holds in developed horse-power per head.

	Steam Plants. Amount	Hydro-Elec. Plants Amount	% of total.
1921	$ 49,858,000	$45,808,000	48%
1922	100,543,000	63,790,000	39%
1923	209,417,000	74,396,000	26%

—*Electrical Review.*

30,000 People in Attendance

Hydro-Electric Power Demonstration

At the Ploughing Match of the Ontario Provincial Ploughmen's Association, at Brampton, October, 16, 17 and 18, 1924

THE Ploughing Match which was held by the Provincial Ploughmen's Association at Brampton this year, was favored with very good weather, resulting in a very large attendance. It was estimated that during the four days there were 75,000 people visited the grounds where this demonstration was made.

The farm of Bull Bros., one mile South of Brampton, was the site selected for this contest and on account of its size and layout, proved to be perhaps a better location than some of the others on which Association contests have been held in the past. The buildings and their equipment were of much interest to visitors, the electric service supplied to the place,

Headquarters and Demonstration Tents

2,800 Paid Parked Automobiles

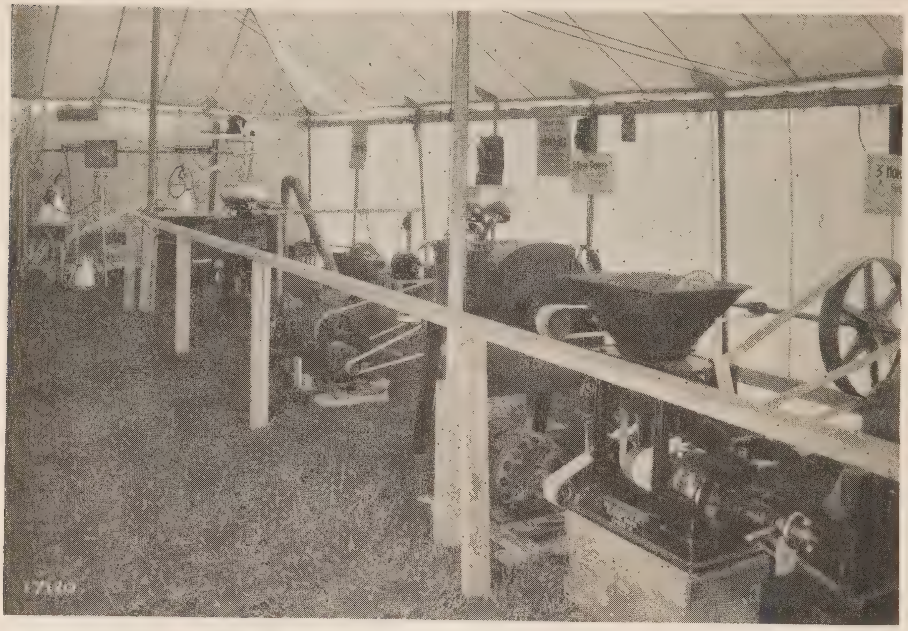
coming in for a good deal of attention, and as the home and barns are particularly well equipped electrically and otherwise, the visitors gave as much attention to the details of the equipment as to the famous herd of Jersey cattle.

In the set-up of the demonstration, two tents, 20 ft. by 40 ft., were erected tightly fastened to the Headquarter's tent, making quite a pretentious appearance, as shown in the illustration.

An extension of line had to be made, approximately 1,200 feet, and a 15 kilowatt transformer installed to supply lighting for the tents as well as power for the various demonstrations.

The Hydro Demonstration consisted of two main parts. In No. 1 tent were appliances of all kinds for use in the home, and in No. 2 tent, some appliances and equipment which might be advantageously used in the barn and in

"Home" Section of the Demonstration



Barn and Dairy Section of the Demonstration

the dairy. In the "Home" section, the uses included the application of electricity to heating, cooking, washing, refrigeration, ironing, and ordinary appliances as found in the homes of our urban centres.

The cooking equipment included standard stoves of several kinds—the semi-fireless cooker type and the automatic fireless cooker type. The water-heater was installed in a barrel, as a substitute for the ordinary hot water tank as found in homes.

In the Barn and Dairy Section, set-ups were made with a section of line shafting for each. The barn section was driven by a 3 h.p. motor and to it was belted a root-pulper, a ball-bearing farm chopper and a cutting-box; provision was also made for the driving of a saw outside, by installing a pulley on the end of the line shaft. The dairy section line shaft was driven by a ½ h.p. motor, to which was belted a power drive cream separator and a pump. Adjacent to this was shown a ½ h.p. motor not in use but mounted on a box and in another corner, a cream separator driven by an individual motor.

Beyond the enclosure was a milking machine with a sectional set-up, cut-out sections in the pails, a phantom cow and imitation milk. In another section an individual water system was installed. This does not appear in the cut shown.

In addition to the electrical equipment shown in the cuts, a small power fan was installed connected with an underground flue with a discharge underground, to a stack outside. This served as a substitute chimney, for two stoves. While the purpose of the installation was to demonstrate a pos-

sible use of this type of equipment for pig pens and chickens houses, it added to the comfort of those in attendance.

All the equipment in the barn section was kept in operation all of each day.

Manufacturers' representatives were in attendance with their equipment, to give information pertaining to its uses. In both the household and barn sections, Hydro representatives were in attendance to give information pertaining to the securing of appliances or of electric service.

The panoramic picture above, was taken at a time when there were 2,800 paid parked cars, as well as the cars of exhibitors, officials and others who were entitled to entrance on passes. The crowd was estimated to be about 30,000 people.

Large numbers were constantly passing through and were apparently very much interested in the different uses that Hydro-Electric service could be applied to, in the home and on the farm.

"For it's always fair weather when School Men get together."

Fifth Annual Re-union

Engineering Alumni Association
University of Toronto

November, 7, 8 and 9, 1924

Address all enquiries to Engineering Alumni Association
Room 315, 57 Queen St. West, Toronto - - - Telephone: Adelaide 4667

Great interest in the Re-union has already been shown by enquiries received from distant parts. Come and meet old pals you haven't seen for years.

1925—Hydro Calendar

On the opposite page are illustrated the various pages of the new 1925 Hydro Calendar, a copy of which was sent to every Hydro Municipality.

These Calendars are to be distributed to every Hydro consumer in the Province, through the Municipalities, and the Municipalities are asked to purchase a sufficient number at approximately 9¢ to supply every consumer with one.

Already over 200,000 copies have been spoken for, and it looks as though well on to 300,000 copies will be disposed of altogether, if not more.

No Hydro Municipality can afford to deprive its customers of this very beautiful and useful souvenir of Hydro. If you have not already sent your order in, get it away at once, so that it will not be too late to be in the swim.

Calendars will be supplied to Utilities outside of Ontario, at the above price also.

This is the first attempt to get out a Hydro Calendar.

Let us make it a complete success.

Co-operate


1925 JANUARY 1925
1925 FEBRUARY
1925 MARCH 1925
1925 APRIL 1925
1925 MAY
1925 JUNE 1925
1925 JULY 1925
1925 AUGUST
1925 SEPTEMBER 1925
1925 OCTOBER
1925 NOVEMBER
1925 DECEMBER 1925

Electricity on Farms

ACCORDING to a recent bulletin of the New York State Committee on public utility information, the first congress of the National Federation of Societies for Rural Electrification will be held at Lyons, France, during October. At the congress, which has the support of the government departments of agriculture, public works and the interior, will be considered the various problems dealing with the increased use of electrical energy on the farms of France, and the wider distribution of electrical service throughout the country. Though some engineers on this continent believe that economic limitations will prevent general rural electrification, this news from France will encourage those who have faith in the eastern super-power program and who see in it the promise of a vast development of electrical energy from water power and coal. What may now be economic limitations in the form of costly distribution lines may not long continue so to be. Practically all that has been done in electrical invention has been done in the life time of Edison, who is still busy, and in that of Steinmetz, who died a year ago. Before the end of another generation it is reasonable to believe that advances, now little more than dreamed of, will be made in both conversion of fuel and water power into electrical energy and means for its distribution. Even in the United States, which has not hitherto been under the same pressure felt in European Countries and in Ontario to seek electrical energy as a substitute for fuel, signs of a coming change are apparent. Increasing coal prices afford weighty evidence on the side of those who contend that the transportation of coal has become an economic waste and that this waste can be avoided only by distributing it in the form of electrical energy. England is vastly concerned just now about its power situation, and England only a few years ago was considered as independent as the United States, in the matter of energy for industry.

Nevertheless, in certain directions European Countries seem to be moving faster in experiments with electricity. The director of the United States geological survey attended the recent world power conference in London and has reported to the Secretary of the Interior at Washington that European Countries appeared to be much advanced concerning the utilization of electricity on the farm, in the household and in other small but important ways. Moreover, the report tells of a visit to a Sussex farm and describes how an "electric farmer" makes hens lay twenty per cent. above the normal by artificial daylight. This R. Borlase Matthews, of East Grinstead, lights his hennery scientifically, also his apiary and his dairies. The electric light in the barns saves the cost in spilled milk as well as encouraging egg and honey production elsewhere on overtime schedules. Electricity furnishes heat, ventilation and moisture control on a larger scale and automatically all over this farm.

The United States expert dilates more, however, on the way this English electrical farmer makes hay while

the sun doesn't shine. The electric making of hay, as he practices it, is not a matter of electric heating or curing, but rather a ventilating process. The green hay is brought to the large mows, 60x20x25 feet high, directly from the field as cut, and is built up as cured hay would be put into the mow, except that the mow is provided with air-ducts and built-up flues. As the green hay begins to heat, this is detected by the thermometers and the temperature is kept under control by electric ventilating fans.

Bacterial action is thus stimulated, but kept under control, and not only is there independence of the sun in the process, but the product is said to be better. A 5-horsepower electric fan is sufficient to cure the hay in a 100-ton mow, and the actual operation is only one and a half hours a day for nine days. After the hay has been electrically cured, the same portable motor is taken to another point for curing grain, which is taken direct from the binder to the rick, and cured by this method. Time and labor losses are thus avoided, and the land cleared for immediate plowing, while the product is wheat that brings a better price from the millers, barley that is regarded as better suited for malting, and oats that are at least better looking than if field cured. The experiment also was tried of thus curing field peas, with the result that they turned out green in color rather than brown.

Electricity also is used on the Matthews' farm in the preparation of silage. The base of the silo is wired so that artificial heating of the fresh silage is possible, the quicker action resulting in superior quality and a silo juice that is good for the cows, instead of being a waste product. Mr. Matthews now is engaged in equipping a high tension electrical unit for stimulating plant growth. This phase of electrical culture is still in the experimental stage, but is to be applied on a practical scale. His experience has shown that electric plowing can be done at less than one-half the cost of plowing by a tractor, and, of course, with even a greater saving over the horse plow.

—*St. Thomas Times Journal.*

Association of Municipal Electrical Utilities

Minutes of Meeting of Executive Committee

THE Meeting was called to order at 1.45 p.m., on October 9, 1924, at the office of the Hydro-Electric Power Commission, Toronto, by the President, Mr. J. E. B. Phelps. Other members of the Executive Committee present were Messrs. J. E. Skidmore, J. G. Archibald, G. J. Mickler, E. J. Stapleton, V. S. McIntyre, O. H. Scott and S. R. A. Clement, Secretary.

The purpose of the meeting was the preparation for the Winter Convention of the Association and arranging details of the affiliation of this Association with the Ontario Municipal Electrical Association. Messrs. C. A. Maguire, Toronto, Carl Kranz, Kitch-

ener, and T. J. Hannigan, Guelph, members of the Executive Committee of the Ontario Municipal Electrical Association being present, the question of affiliation was taken up first. After discussing this subject at some length it was moved by Mr. C. A. Maguire and seconded by Mr. V. S. McIntyre, —That the Secretaries of the two Associations meet and draft a scheme for affiliation to be submitted at the next meetings of the Associations.

Carried.

As it is the desire that the two Associations hold Conventions running concurrently, meeting together for joint sessions and for the convention dinners, the Executive of this Association was asked to prepare for its Winter Convention as usual, except providing for one joint session of the two Associations, and extending an invitation to the O.M.E.A. to attend its luncheons and convention dinners, the O.M.E.A. to share in the cost of these.

Copies of the pamphlet prepared by this Association, "Policy and General Rules for the Operation of a Hydro Shop", were handed to the members of the O.M.E.A. Executive for approval at its next meeting.

Plans for obtaining greater publicity as to the work of the two Associations were discussed and a report was drafted for newspaper publication regarding the action taken at this meeting after which the members of the O.M.E.A. Executive retired.

The Winter Convention of the Association was then considered. It was moved by Mr. O. H. Scott, and seconded by Mr. E. J. Stapleton,—That the next convention of this Association be held at the King Edward Hotel, Toronto, on January 29 and 30, 1925.

Carried.

The following general programme was approved and the various committees were instructed to make their arrangements accordingly.

Thursday, January 29th.

Morning—	Registration.
Noon—	Convention luncheon.
Afternoon—	Business and Technical Session, papers to be obtained by Mr. McIntyre.
Evening—	Convention dinner.

Friday, January 30th.

Morning—	Joint Session with Ontario Electrical Association, to be presided by the President of that Association and to take up subjects as arranged by it.
Noon—	Convention luncheon.
Afternoon—	Commercial Session papers to be obtained by Mr. G. J. Mickler.

Messrs. A. S. McCordick and W. R. Greenshields, members of the Convention Committee, having come in during the discussion of the convention arrangements, asked that representatives from the Toronto Hydro-Electric System be added to that committee. The President named, Messrs. A. W. J. Stewart and T. R. C. Flint as additional members of the Convention Committee.

The meeting adjourned at 4.00 p.m.

Two Important Electrical Associations Complete Affiliation

THE Ontario Municipal Electrical Association is composed of Public Utility Commissions, Municipal Councils and Committees of Ontario. The Association of Municipal Electrical Utilities is an organization of Municipal Electrical Utilities in Ontario, represented by the Managers, Engineers and other Officials. The two Associations have decided to unite for the common good of the electrical interests of Ontario.

The former Association was organized to take united action on all Public Utility matters; to endeavour to obtain a standardization of equipments, operation and general management of Municipal plants; to work in conjunction with The Hydro-Electric Power Commission in promoting development of Public Utilities to suggest legislation which may be deemed of advantage to the Municipalities of the Province. The latter was formed for the mutual assistance of its members by education along technical and commercial lines and to encourage standardization of methods, apparatus and material. The two have been working separately along somewhat parallel lines for a number of years but united action is necessary at times on matters affecting the common interest of the Municipalities.

The two Associations will meet jointly from time to time to discuss matters of importance and take united action thereon. But each will be under the jurisdiction of its own respective elected officers, holding separate meetings when subjects peculiar to themselves are to be discussed.

M. M. Inglis Leaves Port Arthur

The announcement of the resignation of Mr. Malcolm M. Inglis, Manager of the Public Utilities Commission of Port Arthur, was received by the *Bulletin* with deep regret. Mr. Inglis, who has been connected with "Hydro" in his official capacity at Port Arthur since 1916, having also had charge of the Street Railway, Water Works and Telephone System, resigned from his position at Port Arthur to take charge of the Contract Department of the Brazilian Traction Light & Power Co., at Rio de Janeiro, and to become one of the principal assist-

Malcolm M. Inglis

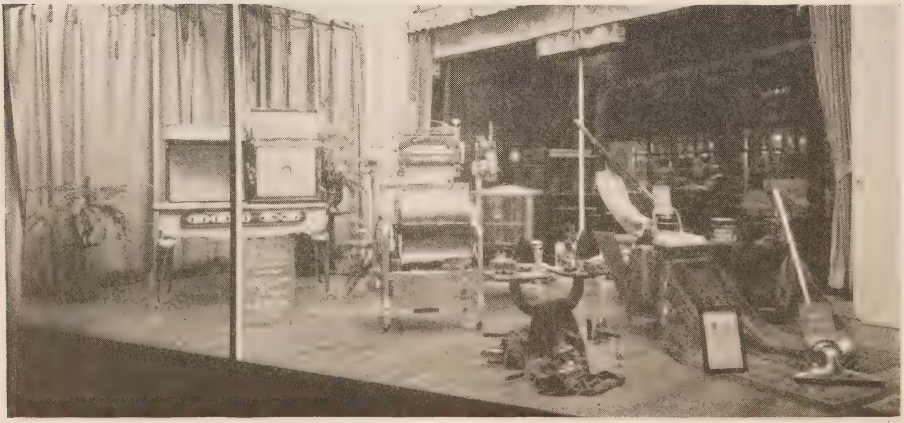
ants of Mr. H. H. Couzens, the Vice-President and General Manager of that Company, and formerly the General Manager of the Toronto Hydro-Electric System. Mr. Inglis relinquished his duties at Port Arthur on August 1st. and sailed for Brazil from New York with his entire family in September. The *Bulletin* wishes him every success in his new position. Mr. Inglis has been succeeded in Port Arthur by Mr. W. T. Brackenreid, who, for a number of years, has been the local representative in Port Arthur and Fort William for Canadian General Electric Company.

Stan. Buckrell Married

A wedding of interest took place on Thursday, September 18th., when Ida Rozetta, daughter of Mrs. Joseph Miles, North Norwich, was married to Mr. Stanley Buckrell, of Tillsonburg. Mr. Buckrell is a valued member of the Tillsonburg Hydro-Electric Commission's staff, having filled the position of superintendent for a number of years. The Bulletin extends to Mr. and Mrs. Buckrell its very best wishes for a happy and prosperous future.

Ack. Hunter a Benedict

On Saturday, September 27th., a quiet wedding was celebrated when Grace, daughter of Mrs. M. Leslie, 233 Havelock Street, Toronto, became the bride of Mr. Alexander N. Hunter, a popular member of the Commission's Engineering Staff. We wish to take this opportunity of congratulating Mr. and Mrs. Hunter, extending to them the heartiest good wishes of all associated with him.



Prizes for Lamp Guessing Contest

Faulty Lighting and Poor Eyesight

Faulty lighting and poor eyesight "are to-day the major factors in one out of every eight accidents," it is asserted by R. E. Simpson, engineer of the Travelers' Insurance Company, Hartford, Conn., in a report to the Eye Sight Conservation Council of America, which is carrying on a nation-wide campaign for better vision in education and industry. Fully 66 per cent. of American workers have defects of vision, according to the report.

In pre-historic times, Mr. Simpson points out, the safety of both man and beast depended upon acuteness of vision. The only natural agent producing glare was the sun, but with the introduction of gas and electricity as illuminating agents, the eye has been forced to contend with new perils.

"Accidents do not simply happen more or less haphazardly, but are caused—there is an underlying reason back of every accident," the report continues. "Often there are many factors not apparent at the time and place of an accident that have some bearing on the cause, and nowhere is this so true as in the matter of ability to see.

"There is indisputable evidence that the momentary and temporary blindness caused by workmen having unshaded lamps close to their eyes and in the direct line of their vision is directly responsible for many industrial accidents. There is also evidence of accidents because of this same kind of blindness due to the specular reflection—more commonly known as glare—from brightly polished material within the range of vision. These and many other evils of illumination prevalent a decade ago were reflected in the accident rate to the extent of being decidedly contributing factors in one out of every four accidents.

"To bring about an improvement there is available only a small number of workers for good illumination, and eyesight conservation compared with the magnitude of the task. For first of all our homes must be better lighted, and this should be supplemented with intelligent and thorough supervision and care of the children's eyes. The illumination in our schools must be brought up-to-date and annual eye examinations of all children must be a permanent policy. By this latter policy eye defects are likely to be discovered early and with proper care the trouble may be arrested. Parents, teachers and school boards must be made to realize their responsibilities, that they are guardians of the coming generation, and that the means to assist them in their guardianship are theirs not by asking, but simply by accepting that which is offered them by experts. There is immense inertia to be overcome and a vast amount of work to be done, principally of an educational kind, before much progress will be noted."

—*Industrial Management.*

HYDRO NEWS ITEMS

Niagara System

A 110,000 volt line is at the present time being built from Oil Springs to Sarnia. This line follows almost a direct line between Oil Springs and Sarnia, easements being obtained along a diagonal road. This line will be operated for a time at 26,000 volts, being connected to the present 26,000 volt line at Oil Springs to increase the transmission capacity to Sarnia. Eventually, an extension will be made to connect with the 110,000 volt lines near St. Thomas, and a step-down transformer station will be built at Sarnia. This is the first 110,000 volt line in the Niagara District, using wood pole construction, the construction being similar to the line built from Nipigon Station to Port Arthur.

The poles are 45 ft. 8 in. tops spaced 325 ft., partly southern pine pressure treated and partly eastern and western cedar, all butt brush treated. The cross arms are of wooden wishbone construction, insulators, suspension seven string, and conductor 3/0 steel reinforced aluminum.

As an experiment, the telephone line instead of being aluminum with steel core, is aluminum core with steel armour, consisting of .066 in. steel strands, the aluminum core is also .066 in. diameter.

* * *

The two new stations constructed to supply the north section of Toronto, one being located at Wiltshire Avenue, in West Toronto, and the other at Bridgman Avenue, adjacent to the Davenport transformer Station, have been placed on load. These Stations are supplied by a 110 kv. line constructed from York transformer Station. It is expected that this Winter these two Stations will relieve Strachan Avenue to the extent of 40,000 kilowatts.

* * *

No. 2 bank consisting of 5,000 kv-a. units has recently been placed in service in Brant Transformer Station.

* * *

Ottawa System

Construction is now starting on an extension of 5.5 miles of rural line to serve the Village of Manotick and surrounding rural district. This will be 2,300 volt single phase 2 No. 6 conductors and will include two canal crossings.

* * *

List of Electrical Material, Devices and Fittings

Approved by The Hydro-Electric Power Commission of Ontario in September 1924.

Appliances

FESS OIL BURNERS OF CANADA, LIMITED, 47 King St., W., Toronto, Ont.

Motor-operated Oil Burning Furnace.

* * *

CANADIAN GENERAL ELECTRIC COMPANY, LIMITED, Peterborough, Ont.

Rectifier, "Tungar".

* * *

CANADIAN GENERAL ELECTRIC COMPANY, LIMITED, 224 Wallace Ave., Toronto, Ont.

Phonograph Motors, Cat. Nos. C.G.E., 211 and 212.

* * *

WALLACE NESBIT (Submittor), Woodstock, Ont.

EHRICH AND GRAETZ (Mfr.) Elsen-Strasse 90-94, Berlin, Germany.

Flat Iron "Graetzor".

* * *

WHITTAKER FIREPLACES, Windsor, Ont.

Air Heater, Cat. No. 94.

* * *

DUFFIE ELECTRIC MANUFACTURING CO., LIMITED, 1303 Queen St., W., Toronto, Ont.

"Tropical" Water Heaters, Cat. Nos. A15, B30, C45 and D60.

* * *

REED & CAMERON (Submittor), 188 Adelaide St., W., Toronto, Ont.

THE ROGERS ELECTRIC LABORATORIES CO., (Mfr.), 2015 East 65th. St., Cleveland, Ohio.

Curling Iron "Rogers".

THE T. EATON CO. LTD., (Submittor), 190 Yonge St., Toronto.

RENFREW ELECTRIC PRODUCTS LIMITED (Mfr.), Renfrew, Ont.,

Air Heaters, "Eaton Beauty".

* * *

*WAPPLER ELECTRIC CO., INC., 162-184 Harris Ave., Long Island City, N.Y.

X-Ray Apparatus, Models "Bellevue", "King," "National," "Deep Therapy", "Number Five Bedside and Hospital".

* * *

*ROBESON ROCHESTER CORPORATION, Rochester, N.Y.

Curling Irons, Cat. Nos. E6205, E6206.

Flat Iron, Cat. Nos. E6546, E6513.

Toaster, Cat. No. E6404.

Radiant Grills, Cat. Nos. E6450, E6460.

Disc Stoves, Cat. Nos. E6304, E6316.

Chafing dishes, Cat. Nos. E32, 886.

Air Heaters, Cat. Nos. E6215, E6216, "Royal Rochester".

* * *

*ADROIT TOOL CO., INC., 14 Front St., New York, N.Y.

"Adroit Jr." Electrical Soldering Iron.

* * *

*C. U. WILLIAMS & SON CO., 207 E. Washington St., Bloomington, Ill.

Oil-O-Matic Oil Burner, Types D, E, or F.

* * *

*A. KENNETH COULTER (Sub-

mittor), 70 Lombard St., Toronto, Ont.

WARD MANUFACTURING CO. INC., (Mfr.), 937-9 Wellington Ave., Chicago, Ill.

Electric Curling Iron, Types 2BA, 2WA, "Eatonia".

Electric Curling Iron, Types 2BA, 2WA "Ward".

Electric Hair Drying Comb, Types BCA, WCA, "Eatonia", "Ward."

Soldering Irons, Types FA, SA, "Ward".

* * *

Fittings

FACTORY PRODUCTS LIMITED, College & Markham Sts., Toronto.

Cast iron conduit boxes, "F.P.L.", Cat. Nos. 300, 317.

Cast iron floor outlet boxes, "F.P.L.", Cat. Nos. 3000, 3100, 3150, 3400.

Cast iron cutout boxes, "F.P.L".

* * *

*SQUARE D COMPANY, Detroit, Mich.

Receptacles for Attachment Plugs and Plugs, Cat. No. 5001, 1020, 1023, 1030, 1033. Plug 5021.

* * *

*UTILITY TOOL, DIE & STAMPING CO., 2286-90 Smead Ave., Toledo, Ohio.

Outlet Bushing, "Utility".

* * *

Switches

*HART MFG. CO., THE, Hartford, Conn.

Surface Switches (as listed on Underwriters' Laboratories card dated, Aug. 19, 1924).

Combination Snap Switch and Fuse, Cat. Nos. 1918, 1922, 1935, 19352, 19952, 1995, 19351, "Diamond H".

* * *

*HART & HEGEMAN MFG. CO., THE, 342 Capitol Ave., Hartford, Conn.

Surface Switches (as listed on Underwriters' Laboratories cards dated November 20, 1923, and September 5, 1924).

Flush Switches (as listed on Underwriters' Laboratories card dated April 29, 1924).

Fixtures Switches, Cat. Nos. 1058, 1079, 8000, 8111, 8201, 8327, 8510, 20039, 20121, 20155, 20189, 20192, 20253.

* * *

*These devices are under the Underwriters' Laboratories re-examination or label service.

THE BULLETIN

Published by
HYDRO-ELECTRIC POWER COMMISSION
of Ontario

190 University Avenue
Toronto

Subscription Price $2.00
Per Year

The Generation of Hydro-Electric Power in Canada

The Progress in Canadian Practice in Connection with Hydraulic Power Development

By H. G. Acres, Hydro-Electric Power Commission of Ontario

Extracts from Paper presented at the World Power Conference

(*Continued from October Number*)

PENSTOCK VALVES.

AS a result of the growth in the size and unit capacity of the turbine, the safe and expeditious control of static pressure finally became the most vital of all the ancillary problems of plant design; simply by reason of the fact that the faulty or uncertain control of a proportionately heavy penstock water-column would otherwise introduce an element of personal and investment risk so serious as to largely discount the value of expensively acquired operating efficiency.

The ordinary gate-valve offers an entirely inadequate solution for the problem where high heads are involved, and even for comparatively low heads, in cases where the penstock is beyond six feet in diameter. Similarly, the butterfly valve, while it has a much wider range of application than the gate-valve, becomes a source of serious operating risk as related to the higher order of unit capacities now becoming prevalent in Canadian practice.

The above limitations have naturally developed to a large extent through the almost unavoidable necessity of placing the penstock valve adjacent to the turbine in the larger modern installation, thus subjecting the valve to the pressure of the full static head. This necessity arises primarily from the fact that a valve, at or near the entrance of a large penstock, cannot protect the plant against a sudden or uncontrolled release of the potential energy of the static water-column, such as might occur in the event of a wheel-case failure, or a failure in governor control. A further advantage arises from the saving in time which would otherwise be lost in draining and filling the wheel-case.

CONTENTS

Vol. XI. No. 11

NOVEMBER, 1924

The general specification for a large penstock valve may be written as follows:—

(a) It must be capable of being built in any size necessary to accommodate any conduit, however large.

(b) It must be capable of being designed to operate under any static head, however high.

(c) It must open and close rapidly.

(d) It must be tight under all conditions of service.

(e) Its operation must at all times be safe, sure and positive; in opening under any static pressure, and in closing under the most serious of plant emergencies.

(f) Where very large penstocks are involved, there should also be an automatic closing device.

Obviously, the above specification eliminates the older types of valves, but it has nevertheless been met to a substantial degree, in Canadian practice, by the use of the Johnson automatic plunger valve.

This valve, like the differential surge-tank, is a distinct hydraulic specialty based on simple and inherently sound fundamental principles, and its development has proceeded along lines that should ultimately lead to its exclusive use for the purpose under discussion, if a proper proportion of its comparatively high cost is allocated to the safety insurance which its use makes available to an unusual degree, even under the most onerous conditions of service.

Governors.

The development of the art of speed regulation and control in Canada has been materially influenced and simplified by three factors which are complementary to, but not integral with the governor mechanism itself; namely, the modern methods of controlling the inertia and momentum of long water-columns; the inherent fly-wheel effect of large generators, combined with automatic voltage regulation; and the system fly-wheel effect of the large transmission net-works which absorb the output of the majority of large Canadian installations.

As to the turbine governor itself, the so-called double compensation principle is the accepted basic element of design, together with the utilization of the inherent speed-drop characteristic to maintain stable conditions of synchronism and local distribution on unit groups in parallel, within such normal range of demand as may be fixed by the characteristics of the connected load.

Briefly described, the double compensation principle of speed control, as applied in Canadian practice, involves

first the provision of a quick-acting direct impulse on the turbine gates, which causes an immediate change in their position in response to the initial impulse arising from a change in load, and the consequent tendency toward a change in speed. This primary impulse is effected through a mechanical connection between the centrifugal governor head and a pilot-valve, which in turn releases sufficient governor fluid to enable the servomotors to move the gates. At the same time, there is applied to this initial movement of the gates a primary compensation in the form of a restoring mechanism, which, immediately following the commencement of gate movement, reacts directly upon the pilot-valve, closing its ports, and checking further movement of the gates. As the restoring mechanism is mechanically actuated by the gates themselves, the cycle of primary impulse and primary compensation is entirely self-contained and reciprocal for any one change of speed.

Following the above primary cycle, and coincident with it within a very short interval, a retarded secondary compensation begins to function, usually through the agency of a spring controlled oil dash-pot. This secondary compensation takes control of the gates, and at a greatly reduced rate adjusts them in such a way that normal speed is restored within a small percentage, varying with the magnitude of the load change. This secondary compensation, beside counteracting the hunting tendency induced by the primary impulse on the gates, and which is sometimes only partially offset by the primary compensation, has the further important function of effecting the final gate adjustment in harmony with the amount of absorption or building up of head energy in the penstock, turbine and draft-tube water-column, as induced by load changes, and as related to the normal effective head on the turbine. Therefore, while the primary compensation, in restricting the gate motion, nevertheless allows a considerable amount of initial variation in speed, the secondary compensations overcomes this speed variation at a slower rate, and finally restores the balance between gate opening and load demand, the extent to which the secondary compensation functions being measured jointly by the magnitude of the load change involved, and by the inertia of the water-column.

As the primary requirements of governor operation are precision and reliability, the natural trend of development has been in the direction of simplicity in principle, the reduction of lost motion by the use of a minimum of moving parts, and precise shop work. Arising out of these requirements, there have been several recent innovations in design, among the most interesting of which is the direct fly-ball drive, the centrifugal element being mounted direct on the main turbine shaft, thus obviating the complication and uncertainty of a belt or gear drive.

Another recent improvement of great value is the substitution of automatic plunger valves for gate-valves in connection with the control of the governor fluid. This substitution is particularly useful when changing over from governor to hand control. With

the older type of control the opening and closing of four to six gate-valves involved not only an expenditure of time that could be ill-spared in an emergency, but a serious hazard due to ignorance or carelessness on the part of the operator. The new type of control, on the other hand, enables the operator to simultaneously close all governor control valves and open all hand control valves, or vice versa, with a single movement of one control lever. This operation can therefore be performed so quickly that there is little or no chance of losing control of the unit, and no chance whatever of varying the proper sequence or procedure.

Remote switchboard control has also developed to such a stage that there is considerable latitude as to the location of the actuator, which is sometimes placed on the machine-room floor, in some cases on the switchboard gallery, and in others directly over the servomotors.

As exemplified in the types of governor above described, the double compensation principle, combined with the restoring mechanism, and the load-limiting attachment where necessary, appears to meet all requirements of turbine speed control adequately and safely, and efficient regulation is assured within safe operating limits for all gate movements up to the full stroke of the servomotors.

While the preceding statement is true throughout the full range of hydro-electric plant operation and interconnection, it is not always true where hydro-electric and steam-electric plants are operating in parallel. In many such cases there is a tendency toward unequal distribution of load by reason of the comparatively short time element in governing, and the frequently greater fly-wheel energy, of steam-electric units.

Draft-Tubes.

Recent advantages in the art under this head, in Canada, are largely attributable to the vogue of the "super-turbine". As the unit capacity of turbine installations increased it was found that the unstable regimen of the water-column in the then existing types of draft-tubes so magnified the effects of vortex action and intermittent vacuum as to cause troublesome and often dangerous operating conditions. These conditions manifested themselves variously in the form of pulsations communicated to the penstock water-column, and in periodic vibratory and resonance effects in the power house superstructure which seriously interfered with operating procedure.

Considerable attention has therefore been given, within the last four or five years, to this phase of hydraulic design, and due to an efficient combination of theoretic and experimental research on the part of American turbine manufacturers and their customers, a very gratifying measure of success has been achieved.

The fundamental truth established by these investigations was that there could be no rational basis upon which the performance of various types of draft-tubes might be compared unless a fixed relationship existed between the specified speed of the runner and its elevation above static tail-water level. In other words, the absolute velocity

of the runner discharge has a definite inverse relationship to the elevation of the runner above tail-water, which must be recognized in connection with performance comparisons. With this condition taken cognizance of, or eliminated, a rational analysis of the results of recent important laboratory tests may be attempted with some assurance of reaching correct conclusions.

Of the earlier types of draft-tube, the vertical diffuser was the most efficient, in that it permitted the regaining of an appreciable part of the velocity head of axial flow if properly designed, and if the tail-race were deep enough. However, as the specific speed of the runner increased, the necessary corresponding increase in length of vertical tube and depth of tail-race finally reached a point where capital cost became a controlling factor. This situation was met by an expedient which gave birth to the widely used elbow type draft-tube; namely, the turning upward and outward of the lower section of a vertical diffuser, the result being a hybrid structure of which the upper section was a true draft-tube, and the lower a tail-race, with the junction between the two effected through a quarter turn of such inherent hydraulic characteristics as to largely destroy the respective functions of the other two elements of the structure.

The elbow type draft-tube had a practically exclusive vogue until the specific speed and capacity of the turbine runner had further increased to such an extent that the energy losses in the draft-tube became a matter of serious concern, not alone from the standpoint of efficiency, but by reason of the power and intensity of the disturbances through which these losses became manifest. This condition was of course due to the fact that the tangential or "whirl" component of flow was increasing with the specific speed, and causing a proportionately greater interference with the axial component of flow, as the two traversed the quarter turn into the horizontal or tail-race section of the tube. The result was not only to largely neutralize the benefit of regained axial velocity head in the vertical or diffuser section of the tube, but to restrict the effective waterway area of the tail-race section with vortices and periodic reversals of flow.

The search for a remedy for the above situation led to the development of the so-called "mushroom" type of elbow draft-tube, together with a number of other more or less abnormal variations of the original elbow type, the whole embracing an evolutionary process which found its first rational expression in the White hydraucone.

The White hydraucone is essentially a vertical diffuser so modified as to make it applicable, within feasible dimensional limits, to installations of large unit capacity. This modification is effected by substituting, for the abnormal length of tube and depth of tail-race otherwise required to meet the demand of a constantly increasing specific speed, a horizontal baffle or diaphragm, normal to the axis of the tube, and elevated a short distance above the invert of the tail-race. The falling water-column impinges on this diaphragm, spills over and around its edges into an expanded lower chamber,

from whence the water runs to waste. The function of the diaphragm is to assist the diffuser section in maintaining the integrity of the water-column, or "hydraucone", and to regain velocity head, acting, in an elementary sense, in the same manner as one of the buckets on an impulse wheel. The function of the lower chamber is to carry the "spill" to waste with the assistance of the residual absolute velocity.

The "hydraucone" was a distinct improvement over the elbow type tube, but inasmuch as the discharge from a reaction turbine runner is not purely axial, as in the case of the nozzle of an impulse turbine, the functioning of the "hydraucone", as a velocity head regainer, suffered to an appreciable degree the same disability as the elbow tube, in that it was unable to efficiently reclaim the energy of whirling flow, owing to its inability to control the turbulence of the draft-tube water-column. Nevertheless, the White hydraucone marked the emergence of draft-tube design from a stagnant period during which unsound theory and ill-conceived expediency prevailed, the draft-tube being considered a thing apart from the turbine, except as a convenient means of piping off the runner discharge as quickly and cheaply as possible.

Apart from the incentive arising from a desire for essential rightness of design, a distinctly commercial element has been in a large measure responsible for recent advances in the art of draft-tube design; namely, the fact that the large capacity turbines of the present day permit an appreciable increment of useful power to be reclaimed as the result of a gain of only a fraction of a per cent. in overall efficiency.

Based, therefore, on this double incentive, the object of recent experimental research has been to regain as much as possible, not only of the axial, but of the tangential component of the velocity head of the runner discharge, and to devise means of training the combined axial and whirling flow, through properly shaped water passages, so as to eliminate vibration and transmitted pulsation to the greatest extent possible.

The research work so far accomplished by the principal turbine builders in the United States has demonstrated the faulty basis of conception and relative inadequacy of all forms of elbow type tube and, beginning with the "hydraucone", has developed a series of types, more or less co-related, which have given satisfactory results in commercial operation.

Of the later types of draft-tube so developed, that known as the Moody Spreading Draft-tube has found somewhat general acceptance in Canadian practice.

This tube was conceived in theory and experimentally developed on the basis of the following facts and assumptions:—

(a) That the inverse relationship between the specific speed of the runner and its elevation above tail-water is an essential factor in design, and as such must be fixed.

(b) That the draft-tube is as much a part of the turbine mechanism as any of the other water passages.

(c) That in any reaction turbine, tangential or whirling flow is always present in the runner discharge at part-gate and over-gate.

(d) That in reaction turbines of the higher order of specific speeds there is whirling flow at all gate-openings.

The above conditions are more or less a recapitulation of the previous discussion, and recent exhaustive tests have confirmed, respectively, the fact of their existence or their justification.

The spreading draft-tube has a very essential function in connection with low head turbines of high specific speed, as it improves efficiency throughout the full range of gate-opening. Used with high head turbines of low specific speed, it is of considerable value as related to part gate efficiencies and overload capacity. In the case of high head turbines of very large capacity it is of material benefit, apart altogether from considerations of efficiency, in largely eliminating the operating hazard which would otherwise obtain through the powerful reactions produced by disturbances in the heavy water-column of the draft-tube.

Turbines.

By reason of the limitations imposed in the opening chapter, the scope of the discussion under this head will be limited to the consideration of reaction turbines, as the development of heads in excess of 500 feet has not been sufficiently extensive in Canada, up to the present time, to produce any unusual or distinctive features.

Head conditions requiring the use of impulse turbines are confined almost exclusively to the Pacific Coast region, where there are important developments using the widely known Pelton type runner under heads ranging from 400 to 1,820 feet, and in unit capacities as high as 13,000 e.h.p.

While some interesting variations in impulse runner design are now under investigation and test, nothing has as yet transpired to challenge the supremacy of the Pelton type turbine in the high head field, either in Canada or the United States.

In the reaction turbine field, the primary outstanding feature of Canadian practice has been the adoption of the single runner vertical setting for Francis type turbines. While the original incentive toward this type of setting was undoubtedly due to the large unit capacities involved, its popularity subsequently led to its application through a wide range of unit capacities and speeds, until in Canada to-day this type of setting may be regarded as standard practice, with the horizontal double or multi-runner setting an obsolete type, used only in relatively unimportant installations or in connection with the extension of old plants, where the original commitments rendered any radical change in design impracticable or unduly expensive.

Including the feature above mentioned, it may be stated that since the 10,000 h.p., prototype of the modern super-turbine was installed at Niagara eighteen years ago, the

subsequent advances in turbine design have been directed toward the improvement of efficiency in the broad sense previously defined, including strength, simplicity, and economy in the use of water. In this connection the spreading draft-tube may be looked upon as a development more or less complementary to the use of the single-runner vertical setting, and may be bracketed with it as a joint primary agency in improving the operating efficiency of large reaction turbines.

In large capacity turbines the question of the stiffness and stability of the scroll-case becomes a matter of importance, depending upon diameter and pressure conditions. As between cast-steel and steel plate scroll-case construction there is no definite field of application, beyond a preference for cast-steel in the larger capacities where the static head is in excess of about 200 feet, as the steel plate construction, under such conditions, is subject to deformation and requires the support of a heavy mass of concrete in the power house substructure, while a cast-steel scroll-case, similarly placed, actually contributes to the stability of the power house foundations.

In the matter of cost, there is usually no material difference between the two types, if due consideration is given to equivalent hydraulic characteristics and to the great saving in time and labour which is realized in the field assembly of the cast-steel, as compared with the steel plate casing. Furthermore, the steel plate casing is not susceptible of a pressure test before final installation, so that perfect workmanship and careful inspection constitute the only assurance that the requirements of the design have been met, and that leakage or other defects will not develop under operating conditions.

Another useful feature incorporated in modern Canadian practice is the Rogers' offset lever operating mechanism.

For efficient speed regulation, any change in speed should correspond to a definite change in load throughout the full loading range of the unit, and most governors are so designed that any such change in speed also gives rise to a correspondingly fixed displacement of the servomotor piston. The piston displacement, however, cannot produce a continuously proportional gate movement at all stages of load, as the angular movement of the gates must of necessity be governed by the load on the turbine at the time of such movement, and is therefore a function of the shape of the efficiency curve. The advantage claimed for the offset lever mechanism is that it meets the above requirements more efficiently than the ordinary radial lever type.

In high head turbines of large capacity, the great circumferential dimensions introduce a leakage factor which materially affects efficiency where the ordinary type of seal ring and gate shank is used, and more particularly when the clearances have become enlarged through ordinary wear, or the

action of silty water. This condition has been met by the use of the so-called "labyrinth seal" and by the "Overn disc", both of these devices having been recently incorporated in the design of large Canadian built turbines.

Instead of the ordinary simple seal consisting of a straight annular passage past the crown of the runner into the space under the head cover, and a similar passage past the runner-band into the draft-tube, the labyrinth seal consists of a series of alternately expanded and contracted passages which destroy the velocity head, and reduce the head on the final free jet to a fraction of its original value.

The Overn disc consists simply of two annular rings cast integral with the gate-shank, one at each end of the gate proper. These discs are machined, and are so located as to set flush with the upper and lower distributor plates. Therefore, while they do not in any way obstruct the flow through the gates into the runner, they materially reduce the leakage through the gate-shank stuffing boxes at all times, and also through the upper and lower gate clearances when the gates are closed. This device also provides a very strong mechanical connection between the shanks and the gate itself.

As in the case of the power development as a whole, the basis of high efficiency in a turbine is the provision of water passages of ample section, with abrupt changes in direction of flow eliminated wherever possible, and where such changes are unavoidable, careful proportioning and transitioning. Secondary, but none the less significant factors are the elimination of leakage and other minor refinements as above described, together with accurate shop work. As related to present Canadian practice a gain of one per cent. in the efficiency of a turbine of 40,000 e.h.p. capacity, as a result of the proper consideration of the above factors in the design, would produce sufficient extra power to supply the requirements of an average community of 2,000 population.

The points in favour of gating the turbine back to the point of best efficiency are: first, safe and efficient operation, particularly where long pressure conduits are involved; second, economy in the use of water under high heads, where the gross potentiality per second-foot of water is great, and where artificial storage is a factor; and third, on account of runner deterioration, particularly in the case of very large turbines, where runner replacement involves a material revenue loss.

The matter of turbine gateage has not, in the past received the attention it deserves at the hands of the purchaser. It does not particularly interest the manufacturer, and must be covered, if at all, by the customer's specifications.

With regard to the pitting and erosion of runners, it may be said that super-turbine development has now reached a stage where this condition is no longer primarily a problem of design, but of econo-

mics. In other words, if the customer so specifies, the manufacturer can select a specific speed and supply, at a price, a turbine in which the runner will have as long a period of useful life as the other major elements of the installation.

The outstanding fact, in connection with the above discussion, is that the super-turbine of the present day is capable of converting into net mechanical energy all but seven per cent. of the gross potentiality of the water supply. Extreme conservation in the fixing of specific speed, and the combined effect of further small refinements in mechanical design may possibly raise part gate efficiencies to some extent in the future, and thus produce a slightly more advantageous shape of efficiency curve, but it would really appear that the large Francis turbines of the present day embody the ultimate, for any type, in respect of water economy at the point of best efficiency.

The disability of the Francis turbine, in its finally developed form, is its failure to fully meet the coincident requirements of increasing capacity and speed under low and medium heads, in response to a commercial demand for large unit capacities and reduced installation costs. This disability, being inherent in the type, and purely a function of the practicable upper limit of specific speed, was susceptible of only a partial solution by reverting to the objectionable and obsolete multi-runner setting, so that the designers of both hemispheres attacked the problem from the only angle that promised an adequate solution; namely, the development of a new type of runner.

The effort in this direction resulted in the development of the so-called high speed propellor type runner, which, in its various subsidiary types, is now in commercial use, both in Europe and North America. Of these types, the Kaplan (European), and the Nagler(United States), have a closely similar design and method of functioning, the flow through the runner being purely axial. In the Dubs (European) and the Moody (United States) types, the mode of flow through the runner is more nearly analogous to that of the Francis type, with the further distinction, in the case of the Moody runner, that the direction of exit flow is diagonal with respect to the axis of revolution; hence the trade name by which this type of runner is known in Canada and the United States.

As previously intimated, the unique feature of the propellor type runner is the possession of a specific speed, ranging upward to a maximum which has not yet been fixed by inherent limitations or by installation cost, and so far in excess of the Francis type that it bids fair to revolutionize the development of large water-powers under low heads.

The primary elements of design which combine to give the propellor type runner its high speed characteristics are, first, a designedly induced condition of bodily whirl in the mass of water passing

through the speed ring; and second, the use of runner vanes having a greatly reduced length in the direction of flow, in proportion to their pitch, as compared with the Francis type.

In future Canadian practice, therefore, it is reasonable to anticipate that dependence will be jointly placed on forethought in the primary elements of plant design and the intelligence of the operating engineer, rather than upon the very material increment of mechanical complexity, and subsequent operating hazard, which results from the adoption of any purely automatic corrective agency in turbine design.

Among the obvious advantages to be gained by the use of the propellor type runner, the following may be cited in particular:—

(a) A greatly reduced weight of the revolving element of the unit, and consequently a corresponding reduction in cost, not only of the turbine and generator, but of power house superstructure and cranes.

(b) Large water passages, as compared with the Francis type runner, which provide much more favourable conditions for the safe discharge of ice and other foreign material.

(c) Greater mechanical strength, as compared with the Francis type, due to the greatly reduced overhang of the vane from the crown of the runner. In the case of the diagonal type runner, the overlap of the vanes permits a very long connection between the base of the vane and the hub, and a consequent reduction in fibre stress.

(*Continued in December Number*)

St. Lawrence Power and Navigation Development

By R. S. Lea, Consulting Engineer, Montreal

(*Address before the Engineering Section, British Association for the Advancement of Science, Toronto, 1924. Cuts, courtesy of The Canadian Engineer.*)

THERE is a peculiar fitness, a sort of picturesque propriety, in the fact that Canada has been compensated in considerable measure for the disadvantage of occupying the Northerly half of the continent of North America by certain natural conditions which are directly due to this very situation. At the close of the glacial period, and after the final disappearance of the ice-sheet which covered the whole of what is now Canada, the surface of the land was left with many irregularities, with rivers steep and rapid and fed by great numbers of lakes of all sizes and elevations, the whole be-

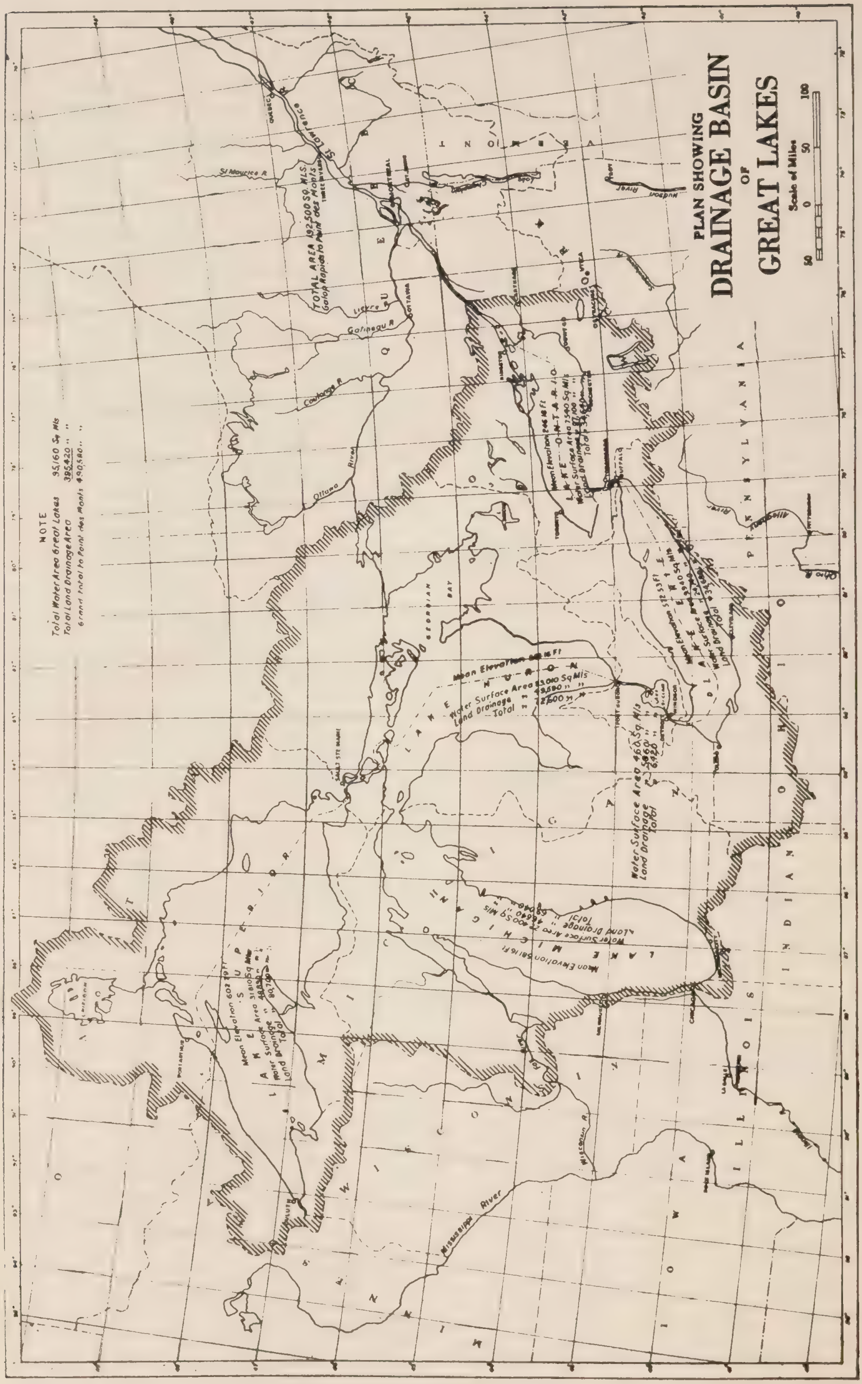


Fig. 1—Geographical Characteristics of the St. Lawrence

ing the work of the great forces exerted and set free by the advancing and receding masses of ice. As this occurred only the other day, geologically speaking, there has been little time or opportunity for the slow levelling-down processes of denudation and erosion to effect any appreciable changes in the physical features and general surface conformation of the country.

All this is particularly true of the action of the great Labrador ice-cap which covered the whole Eastern half of the country, and which created the magnificent and absolutely unique system of elevated inland seas known as the Great Lakes of North America, and the Upper St. Lawrence River which forms their outlet. Here even the largest rivers, such as the St. Maurice, the Ottawa and the Winnipeg, have rapids and falls to their very mouths, and the aggregate water power available is nearly three-quarters that of the whole of Canada; which, in turn, is far greater than that of any other country except the United States.

River St. Lawrence in General.

The boundary line between Canada and the United States passes through the Great Lakes and their connecting rivers, and down the St. Lawrence to Cornwall, whence it continues Eastward along the 45th parallel of latitude. Below Cornwall, the river is wholly within Canadian territory. (Fig. 1.)

The St. Lawrence River, so-called, flows from Lake Ontario to the Gulf of St. Lawrence, a distance of about 600 miles, though its drainage area, which includes the entire basin of the Great Lakes, extends almost to the middle of the continent. It is made up of three stretches which are very different in character. The first 60 miles, from Lake Ontario to Prescott, in which the current is slow and the fall almost imperceptible, may be regarded as an extension Eastward of the lake. It is generally deep, in some places over 100 ft.; and as the minimum depth of the channel is 30 ft., only a small amount of dredging to remove a few projecting shoals, is required to provide for 30-ft. navigation.

The lower stretch, from Montreal to the Gulf, is tidal for nearly its entire length of upwards of 400 miles. From Montreal to Quebec City, a distance of 160 miles, it averages about 2 miles in width, except for a shallow expansion about 7 miles wide and 30 miles long, known as Lake St. Peter. This lake is worthy of notice because of its effect in shortening the season of navigation to Montreal both in Spring and Fall, a point which will be referred to later on. The channel has been deepened where necessary from time to time, until at present a depth of 30 ft. at ordinary low water has been provided. It is proposed to continue this work until a minimum low-water depth of 35 ft. has been secured.

In the third or intermediate stretch of 120 miles, the river falls from virtually Lake Ontario level at Prescott to harbor level at Montreal, through a total height of

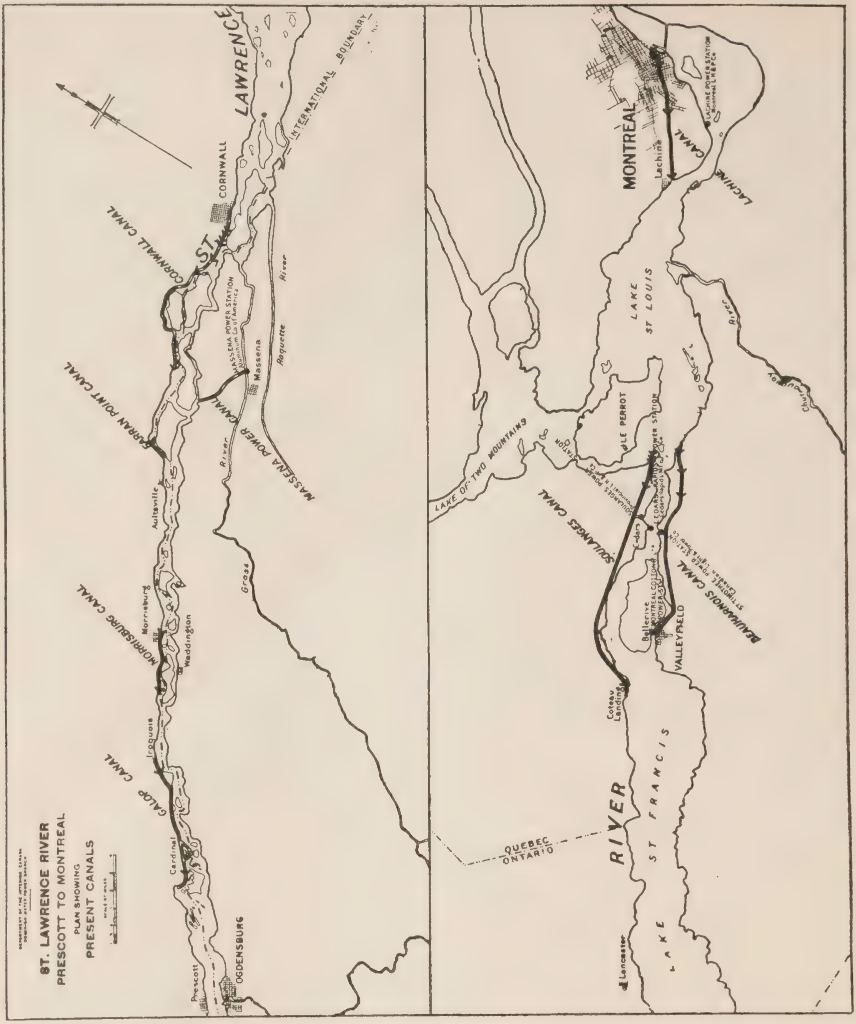


Fig. 2—Existing St. Lawrence Canal System

about 225 ft. It is with the projected development of this portion of the river that the present paper principally deals, because many of the works, including the necessary river improvements, can be utilized for the joint purposes of navigation and power, the cost of such work being divided, with mutual advantage, between the two projects.

The whole stretch, including the rapids, is navigated downstream by passenger steamboats of 6 or 8-ft. draft, and 14-ft. navigation is provided for in both directions by a system of Canadian Government canals around the rapids, which has been available for many years. (Figs. 2 and 2a.) Power has also been developed at different points along the river to the extent of about 350,000 h.p., partly in a small way in connection with the canals, but mainly in three or four plants

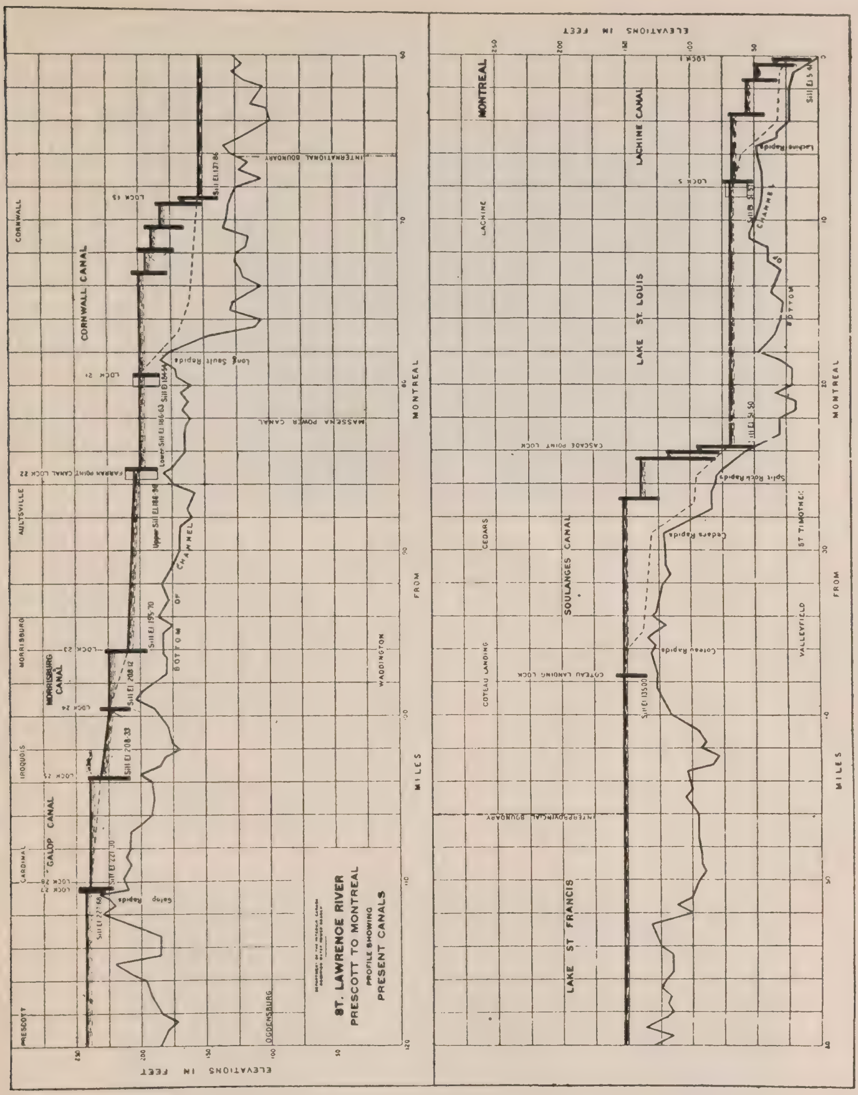


Fig. 2a—Profile of Existing St. Lawrence Canal System

which derive their power by diverting for themselves a portion of the flow of the river. An aeroplane view of the latest and largest of these, the Cedar Rapids plant, with a capacity of about 200,000 h.p. under a 30-ft. head, is shown in Fig. 3, which indicates the general method of development. An interior view of the same plant is shown in Fig. 4. Each of the 18 units has a capacity of nearly 11,000 h.p.

The large-scale schemes which have been proposed within recent years, have been either (a) by certain power interests for the primary purpose of water power development on a scale necessitating the utilization of the flow of the whole river, with provision for present

Fig. 3—Aeroplane View of Cedar Rapids Power Plant

and future navigation requirements, or, (b) as a government scheme for securing deep-draft navigation sufficient for ocean-going vessels, with the incidental creation of opportunities for the development of power. The second scheme is part of a more extensive undertaking, to enable ocean shipping to reach the head of the Great Lakes. It has already been investigated and approved as a whole by the International Joint Commission of Canada and the United States, which is a permanent body empowered by treaty to deal with all questions arising out of the use of boundary waters; and it is being further studied at the present time by representatives of the governments of the two countries.

From either point of view the works proposed are of exceptional magnitude and importance, the minimum ultimate depth proposed for the locks and navigation channels being 30 ft. and the total power when fully developed amounting to from four to five million horsepower, with individual plants having capacities of from 600,000 to 1,500,000 h.p.

It will be convenient at this point to refer briefly to certain interesting, and in many cases unique, characteristics of the Upper St. Lawrence, which have an important bearing on the design, construction, and operation of the development works.

Uniformity of Flow.

This "power reach" of the river is not a river at all in the sense that its discharge is directly dependent upon the precipitation on its adjacent drainage area. The water shed of the entire basin of the Great Lakes, including the lakes themselves, down to the head of the first rapids where the river virtually emerges from Lake Ontario, amounts in round numbers

to 300,000 square miles. From this point down to its junction with the Ottawa, the tributary drainage area of the river is so small as to be negligible. Hence, for all practical purposes, the "power reach" may be regarded as nothing more than an overflow channel for Lake Ontario, and, therefore, for the whole system of the Great Lakes, which constitutes a system of enormous natural storage reservoirs whose combined surface area is 95,000 square miles, or nearly one-half that of the tributary land whose run-off they serve to regulate.

Of the total drainage area just referred to, about one-ninth is directly tributary to Lake Ontario, whose main supply flows into it through the Niagara River, which is subject to the natural regulation of its own storage and that provided successively by the lakes above. Lake Ontario itself, with its 7,500 square miles of surface, provides sufficient storage capacity to receive the entire average inflow from the Niagara and the run-off from its own watershed, with a rise of a little over one inch per day, even with the discharge down the St. Lawrence entirely stopped.

The outflow from the lake is controlled by a ridge of rock crossing the bed of the river about 5 miles below Prescott, which acts as a submerged weir with an average depth of water upon it of about 15 ft. Hence the discharge of the St. Lawrence is directly governed and measured by the elevation of the water surface of Lake Ontario, and the relation between the two has been very accurately determined by a long series of measurements and observations.

The resultant effect of the combination of conditions above referred to, in producing uniformity of outflow, is shown by the records

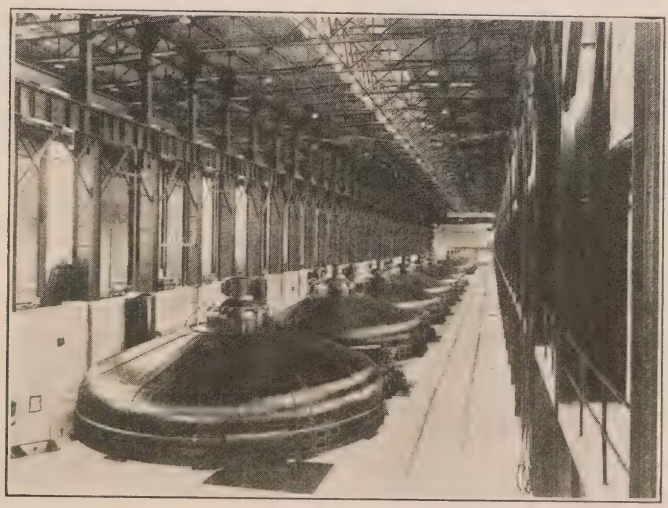


Fig. 4—Interior, Cedar Rapids Power House

and observations of nearly 65 years. The average recorded discharge of the river during this period is about 247,000 cu. ft. per second, which is, however, considerably less than the true average because of the diversion, during the last 20 years or so, of an unknown quantity of water from Lake Michigan into the Mississipi, through the Chicago Drainage Canal. At the present time this is estimated to be about 10,000 sec.-ft. and as a result there is a serious lowering of level in all of the lakes and river channels from Lake Superior to the Lower St. Lawrence, with a corresponding reduction in the power available for development.

In this whole period the lowest and highest recorded (monthly mean) elevations were 243.41 and 248.95 respectively, or an extreme range of about 5½ ft. The corresponding change in the volume of flow was from 193,000 to 320,000 sec.-ft. equivalent to an average increment of discharge of 22,800 sec.-ft. per foot rise in lake level. It is not quite uniform, but for the greater part of the time a change of one foot in lake level will cause a change in the river discharge of from 22,000 to 23,000 sec.-ft.

Briefly summarized, the mean range of level over the whole period is less than 2 ft.; the range in any one year is rarely as much as 3 ft. and has been less than one foot; and for years at a time has varied between 1 and 2 ft. Translated into terms of discharge this means that on the average, and for the greater part of the time, the rate of discharge in any one year varies less than 10% either way from the average of that year; that the average discharge in any year seldom differs by more than 10% from that of the preceding year; that in the worst single year the minimum is about three-quarters of the maximum; and that for the period as a whole the minimum is six-tenths of the maximum. The fluctuations of river level follow closely those of the lake, the range being at some points a little more and at others a little less, depending upon local conditions as to cross-sectional area, slope, etc.

Such natural uniformity of level and flow is, of course, never even approached in any other river, whether subject to regulation or not, and indeed would be extremely difficult to attain artificially in any channel, however elaborate the system of control. In this respect the St. Lawrence stands absolutely alone, and always will.

For purposes of comparison reference may be made first to the Ottawa which, next to the St. Lawrence, is the largest river in Eastern Canada, in which as rivers go there is a high degree of natural regulation; and, second, to the Susquehanna in Pennsylvania, which is a river subject to great fluctuations of flow. In the former the discharge has, under natural conditions varied from a minimum of about 15,000 sec.-ft. to a maximum of 350,000 sec.-ft.; in the latter the range is from a minimum of 2,400 to a maximum of 550,000 sec.-ft. with a frequent high water dis-

charge of over 300,000 sec.-ft.

It is also interesting to note that the changes in discharge from one month to another, and often for much longer periods, could not be detected by an actual measurement. The canal gauges, however, have had their readings carefully related to the discharge by long series of accurate observations carried out by the governments of both Canada and the United States. Hence, from most of them the river discharge can be determined at any time far more accurately than it could be obtained by any single measurement, however carefully made. As they have been read continuously since 1860, they furnish data both as to discharge and slope, of the greatest possible value in detail studies in connection with various hydraulic problems arising out of the proposed development. These gauges have been supplemented by many others set up for this special purpose, and a great number of measurements and observations have been made, giving interesting and valuable information in connection with the hydraulics of the river.

Volume.

The fact that the total drainage area of the St. Lawrence at its mouth is nearly 500,000 square miles, places it at once among the large rivers of the world, although it is far from being the largest. The watershed of the Missouri, for example, is 528,000 square miles; of the Mississipi, 1,245,000 square miles; and of the Nile, 1,500,000 square miles. The Upper St. Lawrence watershed is only 300,000 square miles, yet so far as its low water flow is concerned, it ranks among the largest, and it is probably correct to say that its dependable flow is incomparably greater than that of any river in existence which is adapted to power development. There is no need therefore to dwell further upon the unique position of the St. Lawrence among rivers in respect to volume and dependability of flow.

Regulation.

Remarkable as is this regularity of flow, it can be easily improved, and many important advantages thereby secured. It is quite feasible, and indeed it is an essential feature of the proposed development of the river, to control the discharge at the uppermost dam so as to keep it within considerably narrower limits than at present.

By reason of the slow response in the level in Lake Ontario to any change in the supply, even when the run-off from the local watersheds is excessive, it is not difficult to devise a reliable schedule of control operations by which the regulated flow for each month will depend upon the records of the preceding month. Such a system of regulation has been worked out, and, tested by the records of the last 64 years, it will, while restricting the maximum elevation of lake level to its present height, maintain a mean level one foot higher than the present mean, and a minimum level two feet higher than under present conditions. It will also provide an ample margin of storage

always available for flushing ice and other contingencies. It will have a further important effect in diminishing the quantity of channel excavation necessary to secure suitable navigation velocities at all points to the greatest extent practicable. It will also benefit navigation in the lower river, by maintaining at low stages a greater depth in Montreal Harbor and in the ship channel below, and in lessening the excavation necessary to secure the proposed thirty-five feet depth at low water.

Throughout the "power reach" between Prescott and Montreal, the river flows in a North-Easterly direction, over rather than through, a district composed of glacial drift, largely boulder clay, underlaid by compact rock. As this stretch of the river has only been in existence, from the geological point of view, for a comparatively short period of time, it has had no time to wear out anything in the way of a well-defined valley for itself; and as its maximum discharge is only fractionally greater than its ordinary flow, its channel has adjusted itself to dimensions sufficient to carry a more or less unvarying volume of water. With low banks, its general width averages rather less than a mile, and its mid-depth varies generally between 35 and 50 ft., being shallower, of course in the rapids. Its steady flow and entire freedom from suspended matter, abrasive or otherwise, as it flows out of the lake, has resulted in an extraordinary condition of permanent stability of banks and bed. The territory across which it flows has a slight Northward slope from the Adirondack Mountains in Northern New York, towards the Ottawa Valley, so that, especially in the upper half, the Ottawa River divide is never far from the St. Lawrence, and such tributary drainage area as there is, is on the South side of the river.

In the direction of flow, however, the land falls more rapidly in a series of three main steps or terraces, with comparatively level benches between. These terraces intersect the river, in a generally North and South direction, at the Long Sault Rapids, at the rapids above Lake St. Louis, and at the Lachine Rapids, near Montreal. Down as far as the head of the Long Sault, in a distance of about 30 miles, the fall of 40 ft. or so takes place more or less gradually, and to the foot of these rapids the profile of the adjacent land on either side closely follows that of the river.

As a result of these topographical conditions, the total fall takes place in three different reaches, separated by the river expansions of Lake St. Francis and Lake St. Louis, which occupy the intervening benches. (Figs. 2 and 2a). They are:

(1) From the head of the Galops, (the first rapids) to the foot of the Long Sault.

(2) From the head of the Coteau Rapids to the foot of the Cascades.

(3) From the head of the Lachine Rapids, in Lake St. Louis to Montreal Harbor.

In the upper reach from Prescott to Cornwall, a distance of nearly 50 miles, there is a total fall of a little over 90 ft. About half of this takes place in the Long Sault and the remainder in Farran's Point, Rapide Plat, and Galops Rapids, and in the swiftly flowing intervening stretches of the river. Between 80 and 85 ft. of this fall can be utilized for power development.

Between Lake St. Francis and Lake St. Louis, in a distance of about 15 miles, there are three rapids—the Coteau, Cedars and Cascades, with a total fall of about 82 ft., of which about 78 is available for power.

Between Lake St. Louis and Montreal Harbor, the total fall, including the Lachine Rapids, is about 45 ft. and of this only about 35 ft. can be developed for power at a reasonable cost, under present down-river conditions.

Land bordering on Lake St. Francis and Lake St. Louis is so flat that it is impracticable to raise the water level above the present maximum. The only improvement, therefore, to be made in these lakes, in connection with navigation, is a moderate amount of dredging here and there where necessary for the deeper draft proposed, and no further reference to them would be required except for the difficulties they give rise to, in connection with the operation of the power plants during the winter.

In the upper stretch as far down as Cornwall, the land adjacent to the river, especially on the South side, has such a pronounced slope in the direction of flow that the tributaries tend to follow a course parallel to, and at no great distance from the river itself; so that, toward the lower end it is impossible to raise the river level to any considerable extent, without extensive lateral dams and dykes to prevent overflow into its own tributaries which enter it below the Long Sault.

Foundations and Construction Conditions.

A large number of deep borings have been made at different points along the river to determine the position and character of the underlying rock which is never exposed except in the vicinity of the crest of the rapids. In every case sound bed-rock has been found particularly well adapted to provide solid and impervious foundations, and for the most part at convenient depths.

The steady and dependable character of the flow eliminates the construction difficulties due to sudden freshets, usually met with in river work. It is also, of course, of the greatest value in connection with the operation of the works. On the other hand, this very constancy of flow gives no opportunity to take advantage of periods of low water to install coffer dams or do other early construction work; and at the locations selected for certain of the dams and power houses, there is difficulty in finding room for the necessary diversion on part of the flow during construction. The development of such a large flow under the moderate heads available, requires power

houses of unusual dimensions and capacities; and, on account of the great depths, high velocities, and ice effects, the placing and maintaining of some of the coffer dams will involve work of considerable magnitude and difficulty.

(*Continued in December Number*)

Are You A Smiler?

They put that question to you point-blank out on the coast. From a letter and what was clipped to that letter from C. L. Burgess of the Los Angeles office, you'd conclude that you would have to be a smiler or be an outcast in the realm of the electrical industry.

During the month of February the Pacific Coast Electrical Association put on a campaign under the name of the "Courteous Service Club" to promote the spirit of courtesy and it was planned to enroll every member of the electrical industry. It was void of the usual "entangling alliances," dues and initiation fees. But there was a pledge to smile and be courteous to the public and to the folks you worked with. This thought was boiled down and put into slogan form—"Always With A Smile." The idea went over big out on the coast and no doubt other sections of the country will adopt it.

The eight page folder on india stock and printed in three colors told of the job ahead—"a Big Job." Here's what followed the double page caption:

"A 100% COURTEOUS industry." That's what they'll say of the electrical industry when every man and woman working in this great field is an active and acting member of the COURTEOUS SERVICE CLUB.

It's easy to gain and keep-up a membership. A sunny countenance will pay your initiation fee and a smile will pay your dues.

What the electrical industry needs is big-hearted, broad-minded, whole-souled, frown-free men of energy and action who can look a city or a man squarely in the face and smile.

"He profits most who serves best." And he serves best and profits most himself, who does a worthy work well and shows himself friendly to all he meets.

Courtesy is a habit. The habit of being useful, good-natured and gentlemanly. It smooths over the rough places, cools anger, disarms criticism and builds good will. It makes life rosier for yourself, those who work with you and those you serve.

It isn't hard to be courteous and cheerful. In fact it's the easiest way. It takes 48 muscles to frown and only 14 to smile, so why be grouchy and wear yourself out?

Keep the frown off your face. It is a symptom of a lack of will-power. A smile is the symbol of a purpose worked out.

We're not talking about a smirk, or a grin. We mean a real red-blooded smile that comes only from those who have confidence in themselves and their work and are so glad of it that they have to let the rest of the world know it.

A smile is cooler in summer and warmer in winter than a frown. To be grouchy is to be shunned and disliked, to be good-natured is to be popular, to be popular is to be noticed—to stand out from the crowd—to be successful.

We all have to work in this old world so why not get all the kick we can out of it? Why not go moving forward and making friends as we go?

You can make yourself a better man—your business a better business—your craft a better craft—your city and country a better place to live.

Ours is an industry based on service. No matter what the executives may do, this service is measured by the attitude of the man who meets the public. It's the man at the counter—the man who comes in contact with the public, who determines our success in serving our fellow men. Service with a smile—there is a goal worth while.

As a member of the Courteous Service Club you can determine that every outsider who has dealings with you will go away feeling that the electrical industry is the most courteous in the world.

You can meet the public with a smile on your face that will make friends for you and your company,—a smile that will prove that yours is a service of which the community may well be proud.

You can cultivate that good-natured disposition which will make you a favorite among your fellow workers.

He is worth more who does something as a private than he who does nothing at the head of an army.

Just so, though your work may seem unimportant, if you do it well and with courtesy it becomes more important than a greater task poorly and discourteously performed.

If you believe in your work, your fellow man and yourself, become a member and do your bit to make the electrical industry the courtesy industry. *—Contact.*

Hydro Radio Club

On Wednesday, November 19th., a meeting of those interested was held in the Administration Building and a Radio Section of the Ontario Hydro-Electric Club was formed and a committee appointed as follows:—

A. H. McBride, Chairman; A. E. Clark, Secretary; F. K. Dalton, B .O. Salter, S. L. Eisenhoffer.

A further announcement, as to the proposed activities of the Club will appear in the next issue of the Bulletin.

A.M.E.U.
Winter Convention
At King Edward Hotel, Toronto
January 28 and 29, 1925

Watch for further notices

The Hydro Calendar

On the opposite page are illustrated the twelve pages of the new 1925 Hydro Calendar.

A dummy of the actual calendar has been sent to every Hydro Municipality, and the majority of Hydro consumers in the Province are going to receive a calendar to hang on their walls all of next year.

Municipalities who have not already placed their orders should do so immediately, so that their requirements can be included in the first edition, to keep down the cost, and to avoid delay in delivery.

You do not have to operate a Hydro Shop to get the benefit of this calendar, and every Hydro customer should have one.

Send your order in to the Sales Department, Hydro-Electric Power Commission.


1925 JANUARY 1925
1925 FEBRUARY
1925 MARCH 1925
1925 APRIL 1925
1925 MAY
1925 JUNE 1925
1925 JULY 1925
1925 AUGUST
1925 SEPTEMBER 1925
1925 OCTOBER 1925
1925 DECEMBER 1925

Prosecutions Under The Revised Act Prohibiting Sale Of Unapproved Appliances

At the last session of the Legislature, Section 37 of the Power Commission Act, which deals with the inspection of electrical equipment and installations, was revised and enlarged to provide for regulations respecting inspection, test and approval of electrical equipment. Pursuant to this authority, Rules and Regulations were prepared by the Commission, and approved by Order-in-Council on July 2, 1924. These Rules are given on pages 346 and 347 in the August number of The Bulletin. They have also been published in the technical and trade journals and the attention of all concerned is directed to them.

The following prosecutions have been made for violation of the regulations:

1. On October 9, in Toronto, an electrical manufacturer was fined $10.00 and costs for selling unapproved and sub-standard electric table stoves.

2. On October 14 in Toronto, an electrical jobber was fined $10.00 and costs for selling unapproved separable attachment plugs.

3. On October 14, in Toronto, four hardware merchants and six electrical dealers pleaded guilty to the charge of selling unapproved sockets and attachment plugs and were remanded for sentence.

4. On November 5, in Belleville, an electrical salesman pleaded guilty to the charge of selling 1,000 watt approved electrical heaters without tags noting the restrictions under which such equipment can be used, and claiming that they could be connected to ordinary house sockets. The heaters were also equipped with attachment plugs of insufficient capacity.

He was remanded for one week for judgment.

Although the heaters in question were approved, the manufacturer had violated the regulations in providing them with attachment plugs of insufficient capacity and in neglecting to furnish tags stating that they were not suitable for connection to lamp sockets. The heaters in question can be connected only to circuits or receptacles having a carrying capacity of at least 1,000 watts.

5. On November 6, in Toronto, an electrical jobber was fined $10.00 for selling unapproved sockets.

When any electrical equipment is approved by the Commission, the submittor is officially notified by letter and a copy of the Laboratory's report is sent to him. Lists of approved devices are also kept at all the offices of the Inspection Department of the Commission. A prospective purchaser of electrical devices can thus protect himself either by demanding proof of approval from the salesman or by referring to the Inspection Department or the Laboratories.

Visitors' Column

The Commission has recently had the privilege of entertaining at Niagara Falls, a large number of distinguished Visitors from Great Britain, and although it is impossible to do more than refer briefly to most of them it is thought that even this information would be of interest.

Two of the most prominent of these Visitors were the Hon. Sir Charles Algernon Parsons, and Sir Max Muspratt, Bart. Their long association with science and industry, and particularly their close relations to the electrical industries made them particularly interesting guests.

Sir Charles Parsons is best known as the inventor of the steam turbine which bears his name and which is universally used on land and sea. In the space of a few years his inventions have revolutionized the production of steam power and have, to a large extent, made possible the modern steam plants on which most of the Cities in America are dependent for their supply of power. His name will unquestionably stand alongside that of James Watt as one of the outstanding contributors to the advancement of civilization by the utilization of steam power. Sir Charles is Chairman of the firm of C. A. Parsons and Sons, of Newcastle-on-Tyne, England; Chairman of Ross & Company, Optical Works; Past President of the British Assoc'n. for the Advancement of Science; Director of many Companies and a member of the famous Carlton Club so prominently identified with the down-fall of the Lloyd George Administration and the rise to power of the Bonar Law Government. The Firm of C. A. Parsons & Sons is the only firm in the world that has successfully competed against the best American Manufacturers and sold steam turbine units in the United States on a quality basis. A few years ago this Firm supplied the Commonwealth Edison Company, of Chicago with a 25,000 Kilowatt steam turbine unit, guaranteeing a steam consumption well below that obtainable from American made machines. This unit so successfully met its guarantees that its Owners were able to give it a larger output rating and contracted for a 50,000 kilowatt machine built in England, which has recently been delivered.

Sir Charles was greatly impressed with the Commission's undertakings at Niagara Falls and particularly so with the Queenston Generating Station. He was amazed and perhaps a little incredulous when told that this Plant had an over-all efficiency of better than 90%. The small losses in Hydro-Electric Stations were a surprise to him, and he inquired closely into the method of testing used and compared the results with those obtained from the best Steam Plants which can scarcely show an over-all efficiency of higher than 20%.

Sir Max Muspratt, while not directly interested in the generation

of electric power, as head of the United Alkali Company, Limited, is particularly concerned in the application of power in the Electro-Chemical Industries. As a Chemical Manufacturer and business administrator of the first rank, Sir Max's name is known throughout the world. He is Chairman of the United Alkali Company, whose interests are world-wide, and while not recognized by the general public, its influence affects all lines of business. For some years he was a member of the British House of Commons and in 1917 Sir Max was Lord Mayor of Liverpool. He was one of the leading figures in the production of munitions and for this and other important services during the War a Baronetcy was conferred upon him by H. M. the King. His public services to the British Government and to the City of Liverpool have been recognized from time to time. He is President of The Federation of British Industries, a member of the Liverpool City Council, connected with numerous charitable institutions and a Director of many important companies in Great Britain, the United States and Spain.

* * *

Early in October a visit was paid to Ontario by Mr. W. H. Horton, Distribution Manager for the West Penn. Power Company, Pittsburgh, Pa., Mr. H. B. Vincent, Engineer for Day and Zimmerman, Philadelphia, Pa., and Mr. A. J. Althouse, General Superintendent of the Hamburg Gas and Electric Company, Hamburg, Pa. The object of their visit was to look into the methods of extending electric service to rural districts as applied by the Hydro-Electric Power Commission. These gentlemen, we believe, are members of a state committee which is a part of the federal organization now making a study of the application of electric service to agriculture. Special attention was given to the method of making rates to meet cost, standards of construction, underground distribution and its application to the needs of the different classes of service.

The A.E.S.A. Committee is making a special study of the possible improvement of farm machinery, with a view to extending the time of use with a lower power demand, instead of, as at present, a short period use with a high demand.

They visited Saltfleet Township to see a rural underground system, being specially interested in the form of this construction, with a view to the possibility of the application of similar construction to their own systems.

The visitors were generous in their praise of the achievements in rural distribution by the Hydro-Electric Power Commission, stating that we are much in advance of the United States as a whole, and probably of other countries, in the study of this great problem. They were also much interested in the bonusing of rural lines, the method of its application and the effect it had on the extension of such service.

Hydro News Items

Georgian Bay System

The extension of the Muskoka Development, which constitutes a part of the Georgian Bay System is progressing favorably. The Power House Building has been practically completed, the installation of a new wood stave pipe line is progressing favorably, the first of the new generating units is in transit and it is expected to have the turbine installation completed in the course of the next few weeks. The first new unit will probably be placed in operation about January 1st.

* * *

The transmission line between Muskoka Development and Waubaushene has been completed and tested out and found to be in first class working order ready for tying-in the Muskoka section to the other sections of the Georgian Bay System. The completion of this transmission line gives the Commission an unbroken net work of transmission lines between Huntsville and Windsor, a distance of 300 miles as the crow flies, and approximately 400 miles of transmission lines, being 22,000 v. 60 cycle as far as Mount Forest, and 26,000 v. 25 cycle from Mount Forest to Stratford, and 110,000 v. 25 cycle from Stratford to Windsor.

* * *

The Commission has completed the sale of the equipment at the Midland sub-station to the Public Utilities Commission of that municipality, as well as the sub-station of the G.T.P. Elevator at Tiffin. By this arrangement Midland will take all of its power at 22,000 v. and will have a load totalling approximately 4,000 h.p.

* * *

The Acme Handle Company, a new industry in Grand Valley, has completed the installation of a 42 k.w. enamelling oven. This installation constitutes the first industrial heating unit in use on the Georgian Bay System, and Grand Valley is to be congratulated on securing an industry of this kind, as it proves that the small municipalities are eligible for taking care of any kind of industry which desires location outside of the cities and larger industrial centres. The furnace is three phase, 220 v. 60 cycle, and is constructed in three sections with various degrees of heat possible in each of the individual sections.

* * *

Nipissing System

The new pipe line at the Nipissing Development recently constructed by the Commission, was placed in operation on Tuesday, November 11th. A shut-down of the Nipissing Development was necessary

from Saturday (November 8th.) until Tuesday morning, (November 11th.) in order that the new pipe line might be connected to the head block at the canal and to the penstock at the Power House. The new Bingham Chute Development carried the load on the Nipissing System during this period and the change-over from the old pipe line to the new pipe line was carried out successfully.

* * *

Thunder Bay System

As a result of an election submitting money and enabling by-laws to the ratepayers in September, the Village of Nipigon is now constructing a distribution system and expects to have same ready for service about December 1st.

The Commission is arranging to secure a supply of power from the sub-station of the Nipigon Corporation Pulp Mill to supply the village. This will be the first municipality on the Thunder Bay System other than Port Arthur to receive service.

* * *

The load on the Nipigon Development has been growing rapidly and it has been found necessary for the Commission to operate all four units in order to take care of the demand. The last two units were recently installed, one having been placed in operation in June last and the other in September. The maximum demand carried to date on the plant was 38,000 h.p. in September, and with the peak of the grain rush on at the present time it is expected that the demand this month will considerably exceed 40,000 h.p. The work of completing the development for six units will be continued by the Commission in the Spring, and it is expected that by this time next year the Nipigon Development at Cameron Falls will be completed and the full six units in operation with an installed capacity of approximately 75,000 h.p.

A.M.E.U.
Results of Primary Ballot

The Scrutineers for the election of Officers for the year 1925, Messrs. A. W. J. Stewart and T. C. James, report the following candidates nominated according to Primary Ballots received:

*These names to appear on The Election Ballot.

PRESIDENT:—*V. S. McIntyre, *J. E. B. Phelps, W. R. Catton, O. H. Scott and H. O. Fisk.

VICE-PRESIDENT:—J. G. Archibald, W. R. Catton, V. S. McIntyre, P. B. Yates, J. E. Skidmore, *W. E. Reesor, *R. H. Starr, O. H. Scott, C. E. Schwenger, O. M. Perry, J. G. Jackson, E. I. Sifton, J. J. Heeg, E. V. Buchanan and J. E. B. Phelps.

SECRETARY:—*S. R. A. Clement.

TREASURER:— *G. J. Mickler and *D. J. McAuley.

DIRECTORS:—*O. H. Scott, *W. R. Catton, *J. G. Archibald, *J. E. Skidmore, *P. B. Yates, *J. E. Teckoe, C. E. Schwenger, O. M. Perry, J. G. Jackson, J. J. Heeg, R. H. Starr, E. V. Buchanan, E. J. Stapleton, R. H. Staford, G. W. Blay, E. M. Ashworth.

T. R. C. Flint, R. H. Martindale, R. J. Smith, W. H. Childs, J. E. B. Phelps, J. W. Bayliss, W. G. Ferguson, C. C. Folger, E. J. Sifton, W. E. Reesor, C. T. Barnes, J. E. Brown, H. O. Fisk, V. S. McIntyre, R. M. Parkinson, R. G. Murray, H. F. Shearer, J. H. Bennett, A. B. Scott and J. Vining.

DISTRICT DIRECTORS:—

NIAGARA DISTRICT:—J. G. Archibald, *E. H. Caughell, J. E. Teckoe, *H. G. Hall, E. I. Sifton, A. B. Scott, E. V. Buchanan, O. M. Perry, J. R. Forbes, R. Elliott, L. G. McNeice, J. J. Mason and W. Daykin.

CENTRAL DISTRICT:—J. E. Skidmore, *C. A. Walters, *C. T. Barnes, W. E. Reesor, W. G. Ferguson, G. E. Chase, V. B. Coleman and G. W. P. Every.

NORTHERN DISTRICT: — *T. W. Brackenreid.

EASTERN DISTRICT:—*R. J. Smith.

GEORGIAN BAY DISTRICT:—*J. R. McLinden, *E. J. Stapleton, W. H. Gurney.

List of Electrical Material, Devices and Fittings

Approved by The Hydro-Electric Power Commission of Ontario in October 1924.

Appliances

BRANTFORD WASHING MACHINE Co., LIMITED, Brantford, Ont.

Electric Washing Machine, with heater and ironer attachments.

* * *

HURLEY MACHINE COMPANY, LIMITED, 66 Temperance St., Toronto.

Electric Washing Machine, "Superior".

* * *

INGERSOLL MACHINE AND TOOL CO., LIMITED, Ingersoll, Ont.

Electric Ironing Machine, "Baby Grand".

* * *

UNITED DRUG CO. LIMITED (Submittor), 68 Broadview Ave., Toronto.

THE APPLIANCE MANUFACTURING COMPANY, (Mfr.), Hartford, Conn.

Electric Curling Iron, "Electrex Jr.".

* * *

*PROPP CO., THE M., 524-528 Broadway, New York, N.Y.

Christmas Tree Lighting Outfits, Cat. Nos. 80 and 82.

* * *

*POMINVILLE ELECTRIC WATER HEATER & MFG. CO., St. Hyacinthe, Que.

Electric Water Heater, Style B3.

* * *

*MONOWATT ELECTRIC IMPORT CO., INC., 546 Broadway, New York, N.Y.

Christmas Tree Lighting Outfit, Cat. No. 1000 "Starlite".

* * *

*TAYLOR WELDER CO., THE, 12 Atlantic St., Warrent, Ohio.

Electric Welding Machines, "Taylor", Types S-6-1, S-48-4 incl.

* * *

Fittings

THE DUNCAN ELECTRICAL COMPANY, LIMITED, 2 Inspector St., Montreal, Que.

Medium Base Sockets, "D.E.Co."

Brass Shell, Cat. Nos. 661, 663.

Porcelain Shell, Cat. Nos. 11026, 11029, 11032.

Medium Base Receptacles

Brass Shell, Cat. Nos. 9185, 50717, 60020.

All porcelain, Cat. Nos. 11035, 11036.

* * *

*Heinemann Electric Co., The, 500 Girard Ave., Philadelphia, Pa.,

Cartridge Fuse Cutout Bases, "H.E.Co." (as listed on Underwriters' Laboratories card dated, August 26, 1921).

Plug Fuse Cutout Bases, "G.H.Co.", Cat. Nos. 1935, 2135, 2165, 2199, 2587, 2965, 8042.

* * *

Switches

Canadian General Electric Company, Limited, Hotpoint Works Division, Stratford, Ont.

Combination Snap Switch and Fuse, "Hotpoint," Cat. No. S115.

* * *

Square D Company Canada Limited, Walkerville, Ont.

Enclosed Switches, Fused, Sheet-metal cases, Cat. Nos. 6211, 6311, 6312, 6313, 97312-97316 incl., 97211 8211, 8251, 8252, 8253.

* * *

*Tork Co., Inc., (Submittor), 8 West 40th. St., New York, N.Y.

Automatic Switches—Clock operated Type (as listed on Underwriters' Laboratories card dated April 1, 1924).

* * *

*Keil & Son, Francis, 401-25 E. 163rd. St., New York, N.Y.

Flush Switches, (as listed on Underwriters' Laboratories card dated February 15, 1924).

* * *

*Pierce Fuse Corporation of Canada, Ltd., (Submittor) Bridgeburg, Ont.

Buffalo Fuse Corporation, (Mfr.), 752 Main St., Buffalo, N.Y.

Cartridge Enclosed Fuses—Renewable, "Pierce".

* * *

*Mutual Electric & Machine Co., Detroit, Mich.

Enclosed Switches (as listed on Underwriters' Laboratories cards, dated June 24, 1924, October 16, October 19, 1923).

* * *

Fixtures

Art Statuary and Novelty Co., (Submittor), 106 Front St., E., Toronto.

The Dominion Toy Manufacturing Co., Limited, (Mfr.), 1616 Queen St., E., Toronto.

Portable Electric Lamps, "Dominion Toy Mfg. Co."

* * *

Miscellaneous

*Belden Mfg. Co., (Mfr.), 23rd. St. and Western Ave., Chicago, Ill.

Heater Cord.

* * *

*These devices are under the Underwriters' Laboratories re-examination or label service.

THE BULLETIN

Published by
HYDRO-ELECTRIC POWER COMMISSION
of Ontario

190 University Avenue
Toronto

Subscription Price $2.00
Per Year

Ice Problems At Hydro-Electric Plants

By T. H. Hogg, Chief Hydraulic Engineer, H. E. P. C. of Ont.

Paper Presented at Annual Meeting of the American Society of Civil Engineers at Detroit, October 24th., 1924.

WHEN discussing the problem of ice in power plants, we will consider the various formations of ice which give rise to difficulties in operation, and I have therefore divided up the discussion under the headings of these several varieties in their more troublesome forms.

FRAZIL ICE.

Frazil or "needle" ice consists of ice crystals which form when water is chilled below the critical freezing temperature, but is so agitated or travelling at such a velocity that ordinary sheet ice is prevented from forming. This ice will, of course, be formed in swift moving streams or in rapids. The amount of it carried by the water is sometimes so great as to represent a very large proportion of the total volume of the river or stream. The troubles resulting from frazil ice are of a varied nature, and are very serious in that the accumulation of this form of ice under certain conditions is most rapid and very insidious. In some cases its presence not being known until a total interruption of the water supply occurs.

One of the most frequent troubles arising from frazil ice is the blocking of racks. Ice in this form, travelling in the water, when meeting a cold object, such as the steel rack bar, immediately adheres to the same and builds up on the structure with surprising rapidity, resulting finally in a complete blocking of the entrance or possibly in the failure of the racks due to the unbalanced pressure. I can call to mind in my own experience two instances of failure of rack structures which caused a complete shut-down of the development until the broken members could be replaced. The racks, themselves, in these instances were carried by a supporting steel structure which had not been

CONTENTS

Vol. XI. No. 12

DECEMBER, 1924

designed to resist the full head of water against it, with the result that when the openings became entirely blocked the supporting structure failed. When these racks were replaced the supporting structures in each case were re-designed to carry the full head which it would be possible to have against them, and the rack sections themselves were designed to fail under a much lower head.

Design of Racks.

Where means cannot be taken to prevent the formation of frazil ice and its deposit on the racks, and in cases in Northern latitudes where the racks are carried on supporting structures, these latter should always be designed to withstand the full head which might come from complete blocking of the racks. Thus a blockage from frazil ice can only result in a shut-down until such time as the blocked screens can be removed or broken section of rack replaced, whereas the failure of the supporting structures may mean a shut-down of the entire plant for a considerable period. In plants where the rack section and its self-contained supporting frame is removable it has been our practice to design the supporting frame for a head of only eight or ten feet with a stress close to the elastic limit. If these racks fail the broken section can be readily pulled out and a spare section dropped in. Wherever possible this latter type of construction is being adopted.

Various means for preventing the accumulation of frazil ice on racks have been tried, one of them being the passing of steam through hollow rack bars to keep the metal slightly above freezing temperature. This has met with only small success, as the openings in the rack bars tend to block up and the steam pipes to leak, causing an excessive use of steam and cold portions of rack to which the frazil ice adheres. Another expedient for warming the racks has been the passing of a current through the racks, but this also, as well as the use of wooden racks, has been found to be only partially successful. In all Northern latitudes, if built in the open, the top of the racks should, of course, be kept below low water level, or a building which can be heated to a few degrees above freezing placed over the rack openings. This is very effective in preventing rack blockage.

In some plants the pulling out of the racks during the time of frazil

ice has been resorted to, but of course subjects the turbines to the danger of any foreign matter which may be in the stream. Some years ago in a plant on the Ottawa River, frazil ice became so packed in the turbine casing that the unit was shut down. Examination showed the casing to be practically full of more or less solidified ice crystals. As a means of keeping the unit operating under these conditions a small amount of live steam was turned into the casing and the difficulty overcome as the casing was sufficiently heated to prevent the adhering of the ice. In cases however where this difficulty is encountered very beneficial results no doubt can be obtained by providing concrete wheel casings with series immersion electric heaters, to prevent the frazil ice from adhering to the concrete, as little trouble will be experienced from this form of ice if it can be kept moving. Trouble of this kind can, of course, be experienced only where the location of the turbine is such that no heat reaches the casing or pit from the power house. In the case of vertical turbines either in concrete or metal casings usually sufficient heat is conducted through the head cover to prevent the adherence.

Eliminating Ice Trouble.

The best way of preventing trouble from frazil or other forms of ice is, of course, a large head water pond with a very low velocity which will readily freeze over in Winter time. If such a condition can be secured no trouble from ice need be expected, even in the extreme Northern latitudes. The Hydro-Electric Power Commission of Ontario are now operating a power plant on the Nipigon River in North latitude 49. This plant draws its supply out of a head water reach some 15 miles long, in which the area is such that the velocity is inappreciable. Ice forms on this pond and thickens during the Winter, rotting in place in the Spring. This ice cover protects the water underneath which never reaches a freezing temperature, and thus obviates all trouble from any form of ice. This protective effect is accomplished not only by the ice acting as an insulator proper, but also due to the fact that heat waves of the comparatively long length resulting from the low temperature of the radiating water can not readily pass through the ice into the colder air, whereas the very short heat waves coming from the high temperature of the sun can readily pass through into the water. This protective ice cover is undoubtedly the best means of avoiding ice troubles during Winter operation, and I do not know of a single instance of a plant so situated having had any difficulty from ice.

Anchor Ice.

Anchor ice is the name applied to ice which forms on the bed of a river as a result of the water coming in contact with the bottom, which has been cooled by radiation. The ice adheres to the colder ground or rock as the case may be, and soon builds up a submerged dam. This results not only in a diminution of flow due to this ob-

struction, but also a serious condition may be experienced when as the result of the absorption of bright sunlight the bottom of the river becomes sufficiently heated to cause this mass of ice to break loose. When this occurs the rising mass very frequently carries with it boulders from the river bed. Owing to its more or less porous nature and the presence of this heavier foreign matter large blocks of this ice may float partially or wholly submerged in the water. This enables them to be drawn under protective curtain walls, and if, as is frequently the case, the racks at the entrance to pipe lines or turbine pits have been withdrawn to prevent blocking, these masses may enter, perhaps completely filling the turbine cases. Even though the ice itself may become sufficiently broken up in the turbine to pass through, or may be in blocks small enough to do so, the rocks or detritus embedded in it may be left in the turbine casing or jammed in the gates, perhaps breaking the same or seriously damaging the runners. Trouble from this source has been encountered in several of the plants at Niagara Falls, and while the present day tendency to large units results in openings sufficiently large to pass ice of considerable size, at the same time the danger from the suspended foreign material still exists.

Ice Skimmers.

Various means of preventing the entrance of this ice may be employed, such as ice skimmers, leading to a chute or other disposals, curtain walls, overflow walls. As examples of the latter the installation at the Ontario Power Co. and the Toronto Power Co.'s plants, at Niagara Falls are typical. In these two instances the overflow walls consist of a curving concrete spillway section, which extends from the shores out into the river forming a pool or basin at the upper level of the rapids in which they are located. The elevation of the crest is such that a continuous flow over it of 2 to 3 ft. in depth is maintained, carrying with it a good proportion of the surface ice which has entered the basin. In the case of the Ontario Power Co., the outer end of this basin is protected by a curtain wall set almost parallel to the flow of the river at this point. This proves very effective in deflecting a great deal of the surface ice but neither it nor the overflow from the basin overcomes the difficulty from the low flowing anchor ice.

Gathering Tubes.

Another later expedient is the use of a series of gathering tubes on the river bottom by means of which the water required is withdrawn from over a large area with such a small downward velocity that the suction is not sufficient to overcome the buoyancy of the floating ice. This type of intake in conjunction with the usual curtain wall has been designed for the Chippawa-Queenston canal. Only the curtain wall portion has been constructed up to date, and this has quite effectively prevented the entrance of ice

with the amount of water which up to the present time has been withdrawn from the Niagara River. This type of intake is equally effective against cake or bordage ice which is perhaps the greatest source of trouble on the Niagara River.

Surface and Cake Ice.

Surface and cake ice is the ice which forms along the edges and on the surface of lakes and rivers. Fluctuations in water level or wind, may cause this ice to break up or become loosened and it may then come down stream causing jams or packs with restriction of flow in the lower reaches or forebay. A continual accumulation of this kind may result in a complete stoppage of flow unless some means are provided for its disposal, and also for preventing its entrance into canals or forebays.

The formation of these jams and the filling up of the forebay and entrance chambers are the most serious consequences resulting from this form of ice. Two factors which may play an important part in effects of cake ice are the direction of the prevailing wind and of the current relative to the intake from the river. An instance of this is to be found in the Niagara River where the prevailing wind in the section above the falls is toward the American shore. This drives a large proportion of the ice to the American side of the river and observations have shown that with a heavy run of ice in the river on the American side that the Canadian shore may be practically free.

Good results in preventing the entrance of floating ice have been obtained by the use of booms for deflecting the surface water and ice away from the intake mouth. This method requires for success, a fortuitous direction of wind or currents, since if these tend constantly toward the boom the ice will pile up and force its way under.

One method of preventing the jamming of this floating ice is the use of tugs or ice breakers to maintain an open channel down which the ice can flow with the current, or be carried along by sweeps or drags to a chute or overflow arranged for its disposal.

Immersion Heaters.

As a means of preventing the formation of, or of breaking an ice jam, there appears to be considerable possibilities in the introduction of heat either in the form of warm water, immersion heaters or of rheostats. Attention is drawn to an experiment carried out in a plant in Quebec, where the output of one unit, approximately 6,000 kw. was used by means of a water rheostat to break up a large jam in the forebay. In less than two hours after turning on of the current the ice disappeared, having broken up and passed through the units.

An interesting comparison is to be found between the ice problems which exist on the Niagara and St. Lawrence Rivers. In April, 1909, and again in February of this year to a lesser extent, a serious jam occurred in the Niagara River, the earlier one resulting in a maximum

rise in water level of approximately 60 ft. The river during a period of the Winter of the present year was practically full of ice from Lake Erie to Lake Ontario and in the gorge below the falls was a solid mass, in places 40 ft. thick, extending from Lake Ontario up to above Queenston. This resulted in rise in tailwater level of approximately 15 ft. at the Queenston power house. The reason for this abnormal condition is found in the fact that the open water of Lake Erie extends absolutely unbroken into the mouth of the Niagara River so that the ice which has formed during cold weather over Lake Erie, and subsequently broken up by wind on the lake, flows unobstructed in the funnel-like mouth of the Niagara River. On passing over the falls into the narrow gorge below, this ice piles up with the results as indicated above.

St. Lawrence Ice Problems.

In comparison, I would call your attention to the conditions which exist at the head of the St. Lawrence River. Here we have a great area of land-locked sinuous channels extending from Wolfe Island nearly to Prescott. The climate in this region has more of the characteristics of a Northern Winter than the more or less temperate weather of the Lake Erie region. The ice forms early in the Winter and usually remains until the Spring break-up. Ice formed in the open reaches of Lake Ontario which may subsequently be broken up by wind and driven to this end of the lake, is prevented by this barrier from entering the river and the effective discharge section at the entrance to this barrier is so great, and the resulting velocity so low that suction effect is not sufficient to overcome the buoyancy of floating ice, with the result that it floats here until Spring, and then melts, while the barrier ice itself locked between the shores of the Thousand Islands rots in place. Thus these conditions do not present the dangerous factors that similar circumstances bring about on the Niagara River.

It is seen then that the ice problem which presents itself on the St. Lawrence is one that arises from ice formed in the river itself, rather than from any that is carried into the river from Lake Ontaio. The St. Lawrence River in Winter time becomes a series of alternate sections of open water and ice cover. In the open water stretches bordage ice forms along the margin of the shore, while large quantities of frazil, anchor and slush ice are formed in the ice free channel. This ice is carried down stream by the current to lodge against the upper edge of the ice sheet in the covered section where it is either swept under by the current and carried along until the reduced velocity permits it to rise and adhere to the underside of the ice cover or if the current is not of sufficient strength it builds back or "packs" upstream from the edge of the ice sheet. In either case the ice accumulation causes a reduction in cross-sectional area, and consequent rise in surface level. Under present conditions

serious jams occur on an average of about one year in ten, so that if preventive measures which will undoubtedly be taken in connection with a development of power on the river do not improve conditions over those existing under the natural state of the river, a serious reduction in the amount of energy generated need only be expected at these long intervals.

Cause of Ice Jams.

A study of the history of ice jams reveals the fact that those which have occurred in the upper sections of the river between Barnhart Island and Morrisburg have without exception been caused in the first instance by fields of ice formed in the bays swinging out and blocking the open channel. It has been noted also that this has occurred at certain critical points on the river. For this reason there is little doubt that jams could be prevented by locating proper equipment and taking prompt measures to break open the jam at these critical points.

In the absence of jams the surface slope under ordinary Winter conditions varies but slightly from that which obtains during the summer. In this connection it has been observed in a stretch of the river, of approximately 12 miles, where the marginal ice was formed over 50% of the total area of the river, leaving an open section down the main channel, that for similar discharge the total fall was increased only a few tenths of a foot over that for Summer conditions.

It would appear that the most effective means for combatting the ice problem on this river, is to prevent the formation of ice jams or packs by maintaining an open water channel throughout the full length of the power reach.

In conjunction with this plan of keeping the ice constantly in motion, the various structures should be located so as to offer the minimum of obstruction to the flow of ice in the stream.

Observation has shown that the flowing ice tends to follow either one shore or the other depending on the direction of the wind. By locating the power house approximately parallel to the main flow and in mid-stream and with the provision of wide sluice gates at either end, means for handling a flow of ice under all conditions with the least possibility of accumulation in front of the power house can be provided.

The Generation of Hydro-Electric Power in Canada

The Progress in Canadian Practice in Connection with Hydraulic Power Development

By H. G. Acres, Hydro-Electric Power Commission of Ontario

Extracts from Paper presented at the World Power Conference

(*Continued from November Number*)

WATER-WHEEL GENERATORS.

AS in the case of turbines, the most conspicuous feature of Canadian practice in generator construction, apart from size, and in fact largely due to this factor, is necessarily a most pronounced general tendency toward the use of vertical settings, as evidenced by their adoption in most of the more modern installations now operating, as well as those under construction, or projected. The main reasons underlying this phase of the situation having been covered, it is now only necessary to discuss the resultant effect on modern generator practice.

One factor which it is now proper to emphasize, as having contributed in a very essential degree to the vogue of the "super-turbine", and the popularity of vertical settings in general, is the highly perfected status of thrust-bearing construction.

The development of the art in this latter instance exemplified a condition often met with in the field of engineering, where an inherently sound principle, after having been applied in a primitive way, suffers a period of arrested development, and perhaps years afterwards is practically re-discovered, and becomes the basis of the ultimate solution.

In the early days of hydraulic development, the step-bearing, a form of combined thrust and guide bearing located under the runner, was used almost exclusively for the support of the revolving element. The subsequent gradual increase in the speed and capacity of turbine runners then began to introduce problems of pressure intensity, depreciation and accessibility, which the designers of that day solved, not by improving the step-bearing principle, but by abandoning it, and inaugurating, as a result, the era of the horizontal shaft-turbine. This led to advanced development in bearings of the pillow-block type, together with the introduction of marine type thrust bearings to take up unbalanced runner thrust, a double requirement which gave rise to serious problems when the development of electrical generation and transmission called for continuously increasing turbine capacity and speed.

The orginal turbines installed in

1896 at Niagara represented the first reversion to the primitive basic principle. They were the super-turbines of that period, and were of the vertical shaft type. The revolving weight of these units was partially suspended from, and partially super-imposed upon, a step-bearing located above the runner and immediately below the generator, thus removing one of the main disadvantages of this type of bearing, that of inaccessibility. A further important innovation was the application of external pressure to a film of oil which was forced in between the moving and stationary elements of the bearing. This oil was usually supplied by gear driven plunger pumps at pressures varying from 80 to 350 pounds per square inch, and maintained an oil film from two to four-thousandths of an inch thick between the bearing discs.

The oil pressure thrust bearing had a vogue of many years' duration, and some bearings of this type are still in operation. Their disabilities are: high investment and maintenance cost, mechanical complexity, and high temperature, resulting in low oil viscosity and high energy losses. Also, even a momentary failure of the pressure oil supply usually results in the loss of the bearing.

Finally, in America, about 1898, the ultimate conception was developed by Professor Kingsbury, as the true embodiment of a basic principle first established by the experiments of Tower in 1863, and afterwards mathematically demonstrated by Professor Reynolds. The Kingsbury principle, as exemplified in the various commercial types now in use in Canada and the United States, constitutes an outstanding example of the simple and efficient application of a natural law.

Briefly, this type of thrust-bearing has the following characteristics, which distinguish it from its external oil-pressure prototype, and make it an eminently suitable mechanism for supporting, within comparatively small dimensional limits, the revolving weight of the largest hydro-electric unit.

(a) The source of oil supply is static, and integral with the bearing itself.

(b) The oil supply is "unlimited" in the sense necessary to conform with the laws of viscous fluids, as enunciated by Professor Reynolds.

(c) The formation of the "pressure wedge" is not induced by any external agency, but by the motion of the bearing itself, and by providing for a very slight lack of parallelism between the stationary and moving elements.

(d) The wedge pressure is a direct function of the speed of the moving element, and the thickness of the oil film is a direct function of the fluid temperature, which can be regulated within any desired limits by the simple expedient of water-cooling coils.

In the matter of mechanical simplicity, and therefore dependability,

the merit of the Kingsbury type bearing is evident. Also, the now almost universal practice of mounting the bearing over the generator represents the ultimate limit of development as regards accessibility.

The unique feature of the Kingsbury type bearing manifests itself, however, in the fact that unit pressures as high as 500 pounds per square inch can be used with safety. This means that the basis of design does not need to be a predetermined limit of safe unit pressure, but can be, and usually is, predetermined limit of lost power. In other words, the design of this bearing, for any specific installation, is primarily a problem in efficiency economics, and not of mechanical and dimensional limitations, as governed by safe bearing stresses. Where units of large capacity are involved, the economic power loss seldom works out in excess of one-tenth of one per cent. of the nominal generator rating, the effect of this being immediately reflected in the "speed-no-load" losses of the large modern generator, where the total friction and windage losses are now of the order of one-half of one per cent. of rated capacity.

By reason of the fact that the electric generator has for many years been an efficient convertor of energy, no advance, comparable to that made in the case of turbine efficiency, has been effected in Canadian generator practice; nevertheless, the factor of increased unit capacity has resulted in an appreciable improvement in this regard, to the extent that while 93 per cent. is a fair figure for ratings under 2,000 k.w. efficiencies of 96 to 97.5 per cent. are now realized, in generators of Canadian design and manufacture, for ratings ranging up from 20,000 k.w. in generators of 11,000 to 12,000 volts, and in cases where the generator voltage is 6,600 or less, a further gain of one-half to three-quarters of one per cent. might be obtained.

Probably the most serious problems arising out of the present trend in Canadian practice have been those associated with the purely mechanical features of design. These conditions arose from the necessity of supporting the total revolving weight of the unit from the top of the stator frame; from the use of shafts and circulating oil guide-bearings of large diameter; from the necessity of forced ventilation; and most important of all, from the necessity of maintaining the safety factor in the rotor structure as its weight and cross-sectional mass increased with the generator rating.

As regards this latter problem, Canadian practice embraces the use of two distinct solutions, with the same primary object in view; namely, to overcome, or to offset, the inherent weakness of large masses of steel in the spider casting.

Ventilation is classed as a mechanical problem because, in generators of the class under discussion, it is in almost all cases necessary to dissipate heat by mechanical means. While nothing

radical had transpired in Canadian practice under this head, the ventilation of generators has up to the present time definitely progressed as an art by careful attention to detail and gradual refinement of design, as generator ratings increased. It is now being subjected to further intensive study and experimental research from a more or less original view point.

From the purely electrical standpoint, the main features arising out of the evolution of Canadian generator practice are, inherent regulation and fly-wheel effect, excitation, core loss, and insulation.

The gradual increase in unit capacity has been accompanied by proportionately smaller frame dimensions, and a much greater percentage of inherent voltage regulation, than was hitherto considered permissable. The primary reason for this trend of development has been the perfecting of the automatic voltage regulator, which is now a standard accessory in all important Canadian installations.

One disadvantage of the smaller frame dimensions is a corresponding reduction in fly-wheel effect, but this condition is more or less offset by the fact that large generators are almost invariably connected to a transmission network, so that in the first place, large percentage load changes are not an ordinary condition of operation, and secondly, their inherent fly-wheel effect is supplemented by the very appreciable fly-wheel effect of the system as a whole.

The fundamental idea in all excitation systems is to use every reasonable means to insure continuity of service. This is effected by using two, and sometimes three independent sources of supply. When the speed of the main units is suitable, it is common practice in Canada to use a direct connected exciter as the ordinary source of excitation. In other cases, particularly where direct connected exciters are not practicable, a central turbine driven service alternator installation, usually in duplicate, is used to drive individual motor-generator sets at each main unit; also, where foreign power is available, it is frequently used as an emergency drive for the motor-generators.

The use of direct connected exciters has been the subject of considerable controversy, and there is still scope for argument in connection with economic dimensional limits, as governed by the speed of the main unit. On the other hand, an appreciable energy saving results from the fact that the direct connected exciter has the benefit of the higher efficiency of the main turbine, while at the same time the advent of the automatic voltage regulator has eliminated its main operating disability; namely, the reaction on field intensity due to inherent speed changes in the main unit, on varying load.

The design of magnetic circuits has of recent years been appreciably improved by the use of low loss medium silicon steel in core construction. In generators of large capacity the reduction in core loss,

as compared with previous practice, ranges as high as one-half of one per cent. of rated capacity, for this item alone.

A conspicuous feature of Canadian generator design, arising directly out of the vogue of the "super-turbine", has been the development in stator-coil insulation methods, as governed by mechanical considerations, and the use of higher temperature ratings. Here again, as in the case of rotor construction, Canadian practice includes the use of two more or less distinct types.

To differentiate briefly between these two types, which both employ mica as the dialectric base, it may be said that one type provides for a very high degree of heat resistance, but at the expense of flexibility, as the high percentage of sheet mica employed makes the coils stiff and brittle. On the other hand, the second type provides for flexibility and convenience in handling, but at the expense of extreme heat resisting capacity.

There is very evident merit in the use of insulation with extreme heat resisting qualities in some types of motors, where heavy intermittent overloads are a necessary condition of operation, and where the coils are short and stiff, but in large generators, rating upwards from 20,000 k.w., for instance, low temperature performance is a very important economic characteristic of operation, and the necessity for high heat resistance therefore not such a vital consideration. It is for this reason argued that a more equitable balance is attained by providing an insulation which has at once a reasonable and safe margin of heat resistance, with such a degree of flexibility as will permit handling, and a certain amount of distortion, without injury. This argument still leaves open the comparative hazard, as regards these two types of insulation, arising from the possibility of such a break-down as might result from the current rush of a dead short circuit, and it would seem that the ideal solution involves mechanical as well as dialectric considerations. Such being the case, the best insulation will be that having the highest heat resisting properties, even with the inevitable accompaniment of stiffness and brittleness, if at the same time the slot anchorage and the bracing of the end turns can be so designed as to preclude any possibility of coil displacement or flexure.

As in the case of the Francis type turbine, it is reasonably safe to venture the opinion that, as regards economy in energy conversion, the large Canadian built water-wheel generators of the present day are not likely to be demodernized by future advances in the art.

FUTURE TREND OF DEVELOPMENT.

If the future trend of water power development in Canada were considered in its relationship to other native power resources, as it properly should be, the scope of discussion would be enlarged far beyond the limits originally fixed. If, however, the discussion is confined to hydraulic development "per

se", it may be stated with a fair degree of assurance that the future holds no prospect of revolutionary advances in the art, such as have taken place in the last twenty years.

The means of supporting revolving weights, of safely controlling static pressure, and of regulating long water-columns, have been perfected. The Francis turbine and the water-wheel generator have attained a degree of efficiency in energy conversion which leaves little margin for further improvement. The supremacy of concrete as the structural medium for permanent works stands unchallenged. The larger unit capacities now used in Canada are not likely to be greatly exceeded on sound premises, so that increased unit power concentrations will not in the future give rise to new problems of design.

It would seem, as a matter of fact, that the one conspicuous exception to the ruling condition is the high speed propellor type turbine, and even this advance in the art, while of a revolutionary nature, is more an actuality of the present than a possibility of the future, its merit as a distinct type having been already tested in commercial operation. In other words, the type has been created, and the future trend of development will be limited to the improvement of mechanical details, and to the more important matter of extending the range of feasible operating heads.

A less conspicuous, but nevertheless important subject of future study is the pitting of turbine runners. As stated at a previous stage of the discussion, a means of prevention is fairly well established, but the agency of the actual pitting process is still more or less obscure, and may be due to erosion or corrosion, or a combination of both. If erosion is the controlling agency, then bronze runners should suffer more than those of cast-steel, which is not actually the case. If corrosion is the controlling agency, then cast-steel runners should suffer more than those of bronze, which is in accordance with ascertained facts. If corrosion is for this reason assumed to be the primary cause of trouble, it follows that there must be some purely local condition, induced in and adjacent to the runner passages, which causes oxidation, otherwise the pitting action might as well occur in the scroll-case or speed-ring, which it does not. Under the circumstances, therefore, it might be reasonable to suppose that high velocity, impact and intermittent vacuum conditions, as induced by part-gate operation, tend to disrupt the molecular structure of the water and entrained air, with the result that sufficient free oxygen is released, in and adjacent to the runner passages, to cause pitting through the agency of corrosion.

A much simpler explanation of pitting action might be to the effect that certain portions of the runner surfaces are alternately wet and dry under operating conditions, due to the fact that the curvature and transitioning of the water passages at any point is only perfect for one

critical velocity at that point. If, therefore, such an alternating cycle of conditions persisted continuously for long periods, the oxidation process would function more or less as in the case of an unprotected metal surface in the open air.

The actual cause of corrosion is not, however, essential to the argument, the point being that if the pitting of runners is due to corrosive action in any form whatever, a distinct advance in the art will be achieved if the ideal metal alloy can be evolved; in other words, an alloy possessing the oxidation resisting property of bronze, with the strength and cheapness of cast-steel. The problem would then be solved by reason of the inherent characteristics of the material, rather than by the expensive alternative of low specific speed and low absolute velocities of entrance and exit.

Apart from the specific cases above dealt with, the general problem of the future trend of development will be largely governed by two factors; first, the ultimate necessity of developing water powers remotely situated and not favourably endowed by nature, with a resultant tendency toward increased capital and annual cost; and secondly, a general scale of labour and material costs greatly in excess of that which existed previous to the World War.

If, as previously observed, the above conditions cannot be offset to any appreciable extent by advancing the art from the standpoint of operating efficiency, it follows that future effort must be concentrated on maintaining the present status of efficiency, while at the same time aiming at reduced costs through simplification or revision of the methods and processes by which the present degree of efficiency has been attained.

Under this head, for instance, might be included the use of remote automatic control for low head developments of considerable size, as a means of reducing operating costs; the use of syphonic wheel-pits under low heads, as a means of reducing excavation, unwatering and substructure costs; the use of ejector turbines as a means of reducing the loss of power to a disproportionate rise in tail-water level during high stages of flow; and finally, by the discovery and substitution of cheaper materials, such, for instance, as a new insulating material for generator coils, which would be cheaper and more workable than mica, and at the same time have equal dialectric efficiency and service-ability. This last possibility is perhaps the most important of all.

As a matter of fact, there may be considerable scope for the advancement of the art in the discovery or development of new materials and new combinations of metals, and it would be rash to state that radical and perhaps even revolutionary advances, along this particular line at least, are not a possibility of the future.

Conclusion.

In the opening chapter, the subject matter of this discussion was

designedly limited to the more interesting and more or less distinctive features of a Canadian practice in connection with hydraulic power production, and for an obvious reason. In citing these various features an effort has also been made to summarize, in a general way, the underlying theory involved, and to show that in every instance conformity to natural laws, and a rational comprehension of the phenomena of water in motion, has been the actuating motive.

At the same time, an attempt has been made to convey the impression, more or less by inference, that Canada not only possesses water power resources of enormous extent and value, but has spared no effort to develop them in a manner fully in keeping with their importance as a national asset.

If, therefore, the subject has been presented in such a way as to properly bring out these facts, and at the same time to impress the reader with the fact that in her proficiency in both the structural and purely engineering phases of the hydraulic art, Canada stands to-day on a par with any other nation in the world, the objective aimed at will have been realized.

St. Lawrence Power and Navigation Development

By R. S. Lea, Consulting Engineer, Montreal

(Address before the Engineering Section, British Association for the Advancement of Science, Toronto, 1924. Cuts, courtesy of The Canadian Engineer.)

(*Continued from November Number*)

WINTER CONDITIONS.

FROM the foregoing it is obvious that as regards the flow in the open water months, the conditions in the St. Lawrence for constructing or operating a power plant or navigation system are extremely favorable. During the winter season, however, this is often by no means the case. Ice troubles are common enough in all Canadian rivers, but with a river whose regular flow is ten to twenty times that of any of the other large power rivers of the country, and as great or greater than the flood flow of most of them; and where, quite apart from the rapids, mid-channel velocities run from 5 to 10 ft. per second, the difficulties from ice are also on a much greater scale and often of quite an unusual and complex character. As a matter of fact, the ice is here the crux of the problem of power development and operation, especially where the flow of the whole river is involved.

The upper river as far down as Prescott usually freezes over early in the winter and remains so till spring, when the ice melts in place, or comes down in such a disintegrated condition that it can be handled without difficulty. Below

Prescott the river nowhere freezes across except in the expansions of Lake St. Francis, Lake St. Louis, and Lake St. Peter, and if it were not for them it would remain open throughout to tidewater, and the period of navigation to Montreal would be considerably lengthened at both ends of the season. A large field of ice may bridge the open channel, but this has only taken place with serious effect once in eighteen years in the stretch above Montreal, and could easily have been prevented or dislodged if the proper measures had been taken. In the tidal portion of the river above Quebec, this is more difficult but not impossible.

These lake expansions freeze over early, while the main channel from above the Galops to below the Long Sault Rapids remains open. A considerable area of bordage ice forms in the bays and subsidiary channels and where slack water and eddies occur in the lee of the islands. Beginning early in December this ice, unless interrupted by thaws accompanied by high winds, gradually extends outward, encroaching upon the main channel till a point is reached where the surface velocity is from 2 to 3 ft. per sec., when it practically ceases. Ice of a different kind, however, continues to form in the open water stretches, throughout the winter. Frazil ice forms in open water during periods of intense cold, particularly at night and in cloudy weather. This is the local name for a kind of ice which forms largely at the surface, in slightly under-cooled water, especially when agitated. It occurs as fine spicules or detached crystals, which are disseminated more or less throughout the body of the water by its motion, and which never freeze together to form sheet ice. Anchor ice forms on the bottom in clear cold weather, and when the conditions are favorable to terrestrial radiation. In the rapids of the St. Lawrence both kinds of ice form very readily, even when the weather is only moderately cold. In bright sunshine and with rising temperature the anchor ice loosens its hold on the bottom and rises to the surface, often in large quantities. Fragments of bordage ice detached by winds and currents, and drifting snow, add intermittently to the floating burden of anchor ice and frazil. At one time, ice of this kind gave considerable trouble in the operation of power plants by adhering to and blocking the racks and runners, but with the large capacity single-runner vertical wheels of the larger installations, and with greater experience in the design and location of the plants, these difficulties have been practically eliminated. It may, therefore, now be said generally, and of the St. Lawrence particularly, that it is in the river channels above and below the plants that the principal difficulties with ice are likely to be met with. Where the river can be kept open, this slush ice is therefore of minor importance; but when it meets an ice cover as at the head of Lake St. Francis or Lake St. Louis, it is either drawn

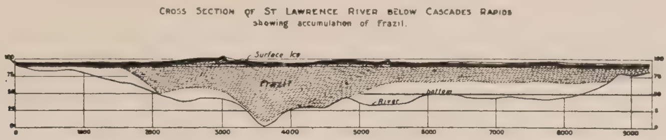


Fig. 5—Cross-Section Below the Cascades Showing Frazil

under by the current, or, when this is not sufficiently strong, it builds back, or "packs" upstream. In the former case it tends to rise and adhere to the under side of the ice cover in the eddies and when it reaches a point of lower velocity. There it accumulates in great masses called "hanging dams," sometimes to a depth of 60 ft. or more. (Fig. 5). The jams thus caused raise the level and back the water up on the rapids next above. When the ice packs, it forms a thick and very rough and irregular cover of tilted ice cakes, masses of anchor ice and frazil, which greatly restrict the flow, and which in itself at once causes a much steeper slope and a consequent upstream rise in water level. The ice-cover in the ship channel between Lake St. Peter and Montreal, is always formed by the packing of ice.

Jams caused by these "hanging dams" form in the river opposite Montreal, sometimes raising the level 16 or 18 ft. and backing the water up on the Lachine Rapids just above. Similar jams form at the head of Lake St. Louis, but not to the same extent; though one year, 1918, the water rose as much as 12 ft. above normal level. More serious jams occur at the head of Lake St. Francis and in the river channels upstream to the Long Sault Rapids, where a rise of 15 ft. is not unusual, and where in 1918, at the foot of Barnhardt Island, the site of one of the proposed power plants, the water rose 27 ft. above summer level.

These are the results of ice jams as they occur at present, and with practically nothing done in the way of prevention or protection except at Montreal. Considerable study has been given to these problems, and there is no doubt that much can be done to improve the conditions by taking measures and carrying out works which will tend to decrease the jams and to assist the river in its natural tendency to keep itself clear.

METHODS OF DEVELOPMENT.

It has already been indicated that in the development of the "power reach" of the St. Lawrence, natural conditions have divided it into three stretches, each of which must be dealt with separately. The two lower ones, which are short and made up almost entirely of rapids, have been shown by the investigations of the engineers of the Government Deep Waterways' project, to be particularly adapted to improvement for navigation by the method of side canals, which work can be carried out quite independently of the development of power. The latter is an important feature,

in view of the fact that both stretches are wholly in Canadian territory. Besides this the development of these powers would naturally and advantageously follow those of the rapids above. The deep waterways' scheme contemplates an ultimate navigation depth of 30 ft., but in making the estimates, provision has been made for an initial minimum depth of 25 ft. in the canal reaches and river channels, with the locks and other permanent structures constructed for the full draft of 30 ft. For purposes of a very general description, it may, however, be considered as a 30-ft. project.

Montreal Harbor to Lake St. Louis.

For the lowest stretch, from Montreal Harbor to Lake St. Louis, several alternative plans for a canal about 9 miles in length have been proposed, differing principally in the route chosen. One of these, which may be the one finally adopted, is shown in a diagrammatic way in Figs. 6 and 6a. It begins with an entrance lock No. 1, in Montreal Harbor, and this numbering is continued throughout the whole stretch of the river up to Lock No. 9, a little above Morrisburg, which completes the total lift. Lock No. 1, with a lift of from 22 to 32 ft., according to the river stage, leads to a section constructed in the river, and carried between an outside retaining wall and embankment, and a levee or flood protection dyke which is already in existence along the river shore. The space thus enclosed may be utilized as a high level shipping basin, forming part of a scheme for greatly increasing the terminal and dock facilities of the harbor. Lock No. 2 is located at the further end of this section, and has a lift of 18 ft. The next section turns Northward towards the present Lachine Canal and leads to Lock No. 3, with a low and variable lift, according to the stage of the river. The canal enters the lake about 2 miles further West, from which point the excavation of a channel is necessary for several

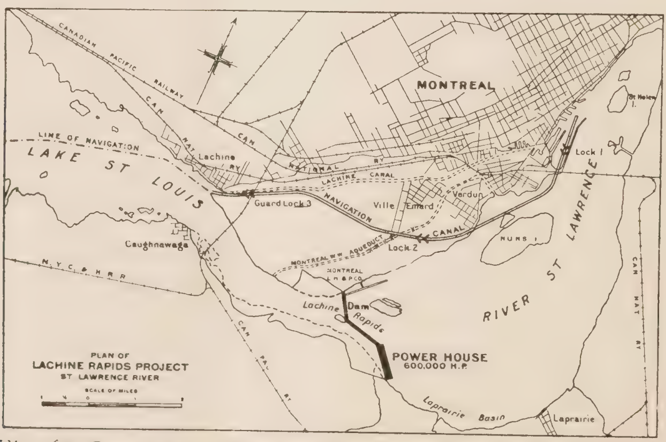


Fig. 6—Government Plan for Lachine Rapids Development

miles before deep water is reached.

The plans provide for locks 860 ft. long and 80 ft. wide, which are the dimensions adopted for the new Welland ship canal, now under construction, between Lake Erie and Lake Ontario. The canal sections are to be excavated to a minimum bottom width of 200 ft. in through cuttings and 450 ft. in the river channels, which is the width of the ship channel below Montreal. A dam and power house is shown in Fig. 6. The dam will control the flow and may be utilized to maintain a low water level in Lake St. Louis 5 ft. or so greater than at present without raising the maximum elevation, and perhaps to provide the increase in depth when the change is made from 25 to 30-ft. navigation.

The 30-ft. project is estimated to cost about $70,000,000, and the power plant about $85,000,000 more, though these estimates do not appear to include interest during construction and certain other overhead charges. The amount of power to be obtained as estimated to be about 700,000 h.p. in summer, but less in winter, due to the ice jams in the river below, which makes this one of the most expensive and least attractive of the different sites available. In any case it should be deferred until the development has been carried out in the second reach between Lakes St. Francis and St. Louis.

Lake St. Francis and Lake St. Louis.

In this stretch the conditions are unusually favorable to the side canal method. Between the two lakes, on both sides of the river, there is a level bench of land for nearly the whole distance, which lends itself to easy canal construction, and in which the total fall is largely concentrated near the lower end where the main lift locks may be conveniently located. It is, of course, possible to canalize the river, but important plants already existing would be interfered with,

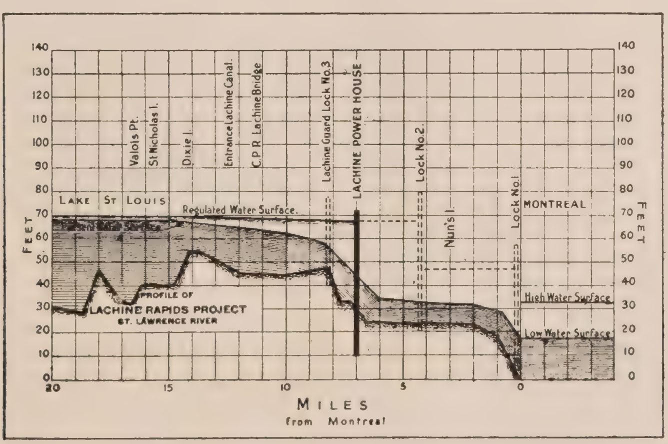


Fig. 6a—Profile for Government Project at Lachine Rapids

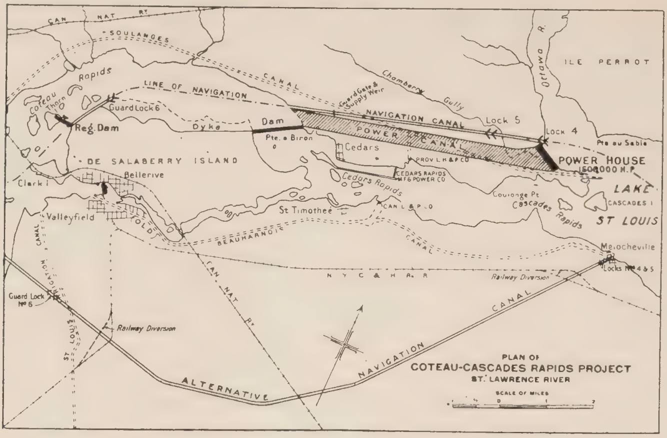


Fig. 7—Two Government Development Plans, Coteau-Cascades Project

and the cost would be otherwise excessive.

The government plans offer two methods of development, both of which are indicated in Fig. 7. In one of these the navigation and power projects are to be carried out as two entirely separate schemes. Navigation is provided for by a side canal on the South side of the river as shown. A double twin flight of locks, Nos. 4 and 5, are located at the lower end near Melocheville, on Lake St. Louis, which will raise the water level to that of Lake St. Francis. A guard lock, No. 6, is located at the Lake St. Francis end, where a dredged channel, with a jetty to prevent cross currents, is carried out for some distance into the lake. The cost of a 30-ft. navigation canal is given as about $40,000,000. The power development is shown on the opposite side of the river. It consists of a dam across the river, between the Coteau and Cedar Rapids, which would drown out the former and bring the Lake St. Francis level down to the entrance of a power canal 1,500 ft. wide and 40 ft. deep, leading to a power house just North of Cascades Point, where over 1,600,000 continuous h.p. can be developed with the whole flow of the river available. Some excavation would be necessary through the crest of the Coteau Rapids. The estimated cost of this power development is given as $152,000,000.

The other method of development considered is also shown in Fig. 7. In this case both power and navigation canals are on the North side of the river as shown, and the dam serves both purposes. At the Lake St. Louis end there is a lock, No. 4, with a lift of 39 ft. followed as shown on the profile, (Fig. 7a), by another lock, No. 5, of about the same lift. A guard gate is located near where the canal enters the river. The main dam, which is provided with spillway and control gates, crosses the river from below the power canal to De Salaberry or Grande Isle, along which it is continued by an embankment

to a partial regulating dam and low lift lock No 6, located near the head of the Coteau Rapids. The estimated cost of the combined navigation and power schemes if carried out at the same time, is given as about $12,-000,000 less than by the first scheme.

PRESCOTT TO CORNWALL.

The general physical features in this stretch of the river have already been shown to differ from those of the two lower stretches. The total fall is distributed over a distance of nearly 50 miles, and, between the three main rapids, the river is navigable in both directions. Investigations carried on for several years by the Hydro-Electric Power Commission of Ontario, in connection with projects for the development of the entire flow of the river for power, have shown that many of the works necessary for this purpose will also be required for the canalization of the river which is the method of improvement most suitable to the natural conditions. This conclusion was also reached by the deep waterway engineers, when studying the question primarily from the point of view of navigation. There are several other reasons why this stretch should be considered in a separate category. For example, it is for its entire length the international portion of the river, in which the power belongs jointly to Canada and the United States, and where the development involves cooperation on the part of both countries. It is also the portion of the river which lies within the boundaries of the Province of Ontario, where the general policy of power development is quite different from that of the Province of Quebec, through which the rest of the river flows. Its improvement is the next step, following in natural sequence the completion of the new Welland Canal in the deep waterways project, and the drowning out of the

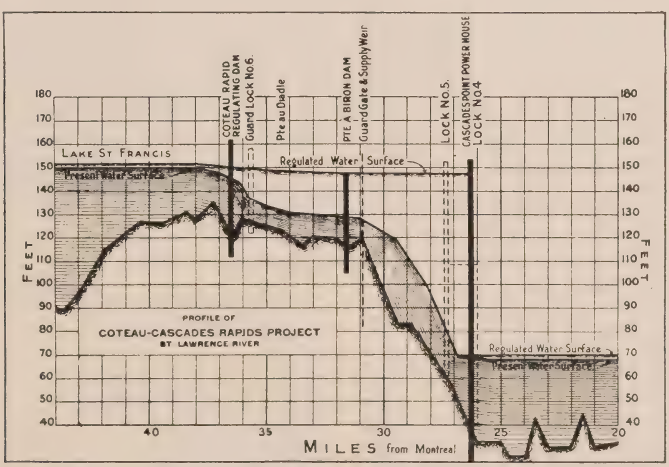


Fig. 7a—Profile Showing Government Proposals, Coteau-Cascades Project

rapids should begin at the upper end of the river on account of the protection from ice thus afforded in the construction and operation of works lower down. And, finally, there is a pressing demand in each country for its share of all the power available as fast as it can be developed.

Two general methods of improvement are possible, a double development scheme and a single development scheme. In the former, the works would be carried out in two stages, the upper of which would include the Galops Rapids and Rapide Plat, and the lower the Farran's Point and Long Sault Rapids. By this method the river would be confined to as great an extent as possible within its present banks. with practically no flooding below Morrisburg. In the single development scheme, the entire fall available for power should be concentrated at the foot of the Long Sault. There would be a regulating dam at the Rapide Plat to control the outflow from Lake Ontario. This method would cause considerable flooding and requires the construction of long and high wing dams, and a number of enbankments of various heights.

SINGLE STAGE DEVELOPMENT.

Figs. 8 and 8a show in a very general way a single stage development very similar to that proposed by the government engineers. As in all schemes for the improvement of the river, a large amount of excavation is required through the Galops Rapids and at various points between there and Morrisburg, in order to secure suitable depths and velocities for navigation and the highest practicable pool level at the dams below. This enlargement of the river channel will necessitate some means of controlling the flow, and this is provided by regulating dams at the Rapide Plat across the channels on each side of Ogden Island. With the water at elevation 245 above the Galops, a normal water level of about 242 can be maintained above the Ogden Island dams. There will be a navigation lock, No. 9, on the United States side with a maximum lift of 10 to 12 ft. From Morrisburg to the Long Sault no channel improvements will be required.

The foot of the Long Sault Rapids is at the lower end of Barnhart Island, and it is near this point that the power plant of the single stage development must be placed in order to utilize the available head. It is impossible to make use of the adjacent shores of the river at this point as they are much too low for the purpose. Fortunately, however, Long Sault Island and both Barnhart and Sheek Islands are considerably higher, and it is only by taking advantage of this circumstance, and by carrying the pool level down between the two latter islands, that a single development becomes practicable.

The normal elevation of the water surface above the Long Sault Rapids is 202, and that proposed below the proposed power plant 155. The proposed pool level is 231, though the power house and other structures are to be designed to

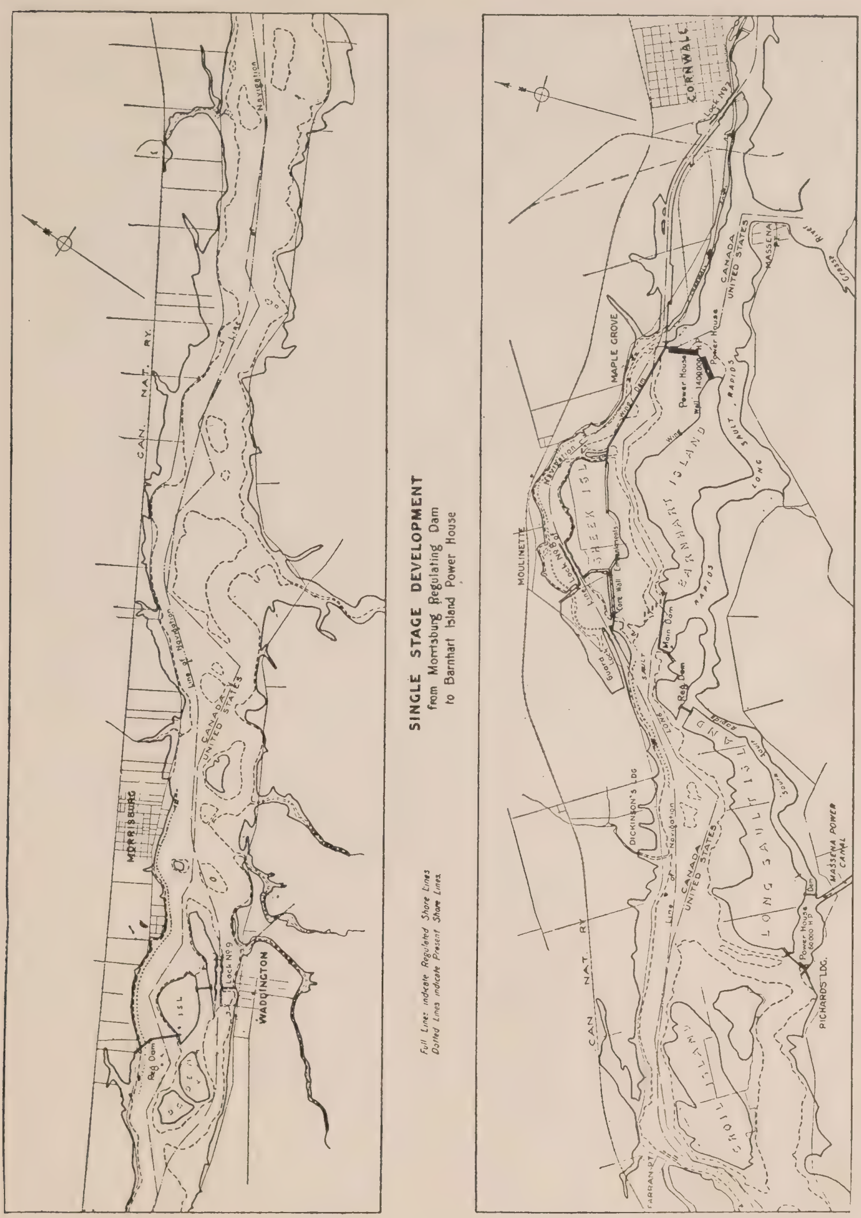


Fig. 8—Proposed Single Stage Morrisburg-Cornwall Development

permit this to be increased by 10 ft. or so. The Little River is the shallow channel which separates Sheek and Barnhart Islands. It carries less than 5% of the total flow and leaves the main channel in the middle of the rapids where the water surface is at Elevation 175. Just below this there is to be a spillway dam about 3,800 ft. long

connecting Barnhart and Long Sault Islands, and provided at each end with a set of Stoney sluices. Its crest will be at elevation 231, and it will therefor serve to divert the main flow into the channel of the Little River and down to the power plant. In order to retain this pool level, a series of lateral dams and embankments are necessary starting from both ends of the power plant. On the North side a retaining wall and embankment over 8,000 ft. long and 100 ft. high connects it with Sheek Island, the upper end of which is, in turn, joined to the North bank of the river by heavy embankments with core walls. On the South side the pool level is carried by way of Barnhart Island, the spillway dam, Long Sault Island, and a dam and power house at the upper end of the South Sault channel, to the main shore of the river. The main shores themselves, for miles further upstream on both sides require embankments at a number of points to maintain the required elevation.

The most important of the structures just referred to, is the spillway dam, which crosses the river at the swiftest and deepest part of the rapids, and which is estimated to cost upwards of $11,000,000. The power house at the head of the South Sault channel is to utilize, under a head of about 28 ft. the water required for the existing Messena power plant, which is supplied from this channel by a power canal 3 miles long, and which discharges into the Grasse River, a tributary flowing at a much lower level.

Navigation is carried from the river at Cornwall up into the pool and past these works by about 7 miles of canal, and two locks, Nos. 7 and 8, located as shown in Fig. 8, and with lifts of 48 and 31 ft. respectively. At the proposed power plant at the foot of Barnhart Island, there will be a Canadian and an American power house. To better provide for the handling of floating ice, these power houses should be placed more nearly parallel to the direction of the current than shown, and space for a number of sluices should be left between their lower ends. Their combined length is about 3,400 ft., sufficient to provide for a total installed capacity of about 1,780,000 electrical horse-power in units of about 34,000 e.h.p.

While it would considerably increase the lateral dams and embankments required, as well as the area flooded, it is quite feasible to maintain a pool level 8 or 9 ft. higher than that adopted for this scheme of development as described above. This elevation, which is that of the crest of the spillway of the main dam, was really determined by the conditions expected during the Winter in the river above the works. Above the Morrisburg dam the enlargement of the channel and the raising of the water level, will considerably reduce the velocity of the current, but it will still be so great as to prevent the river freezing over even in the severest winter. Below Morrisburg, however, a

complete ice cover will form at the lower end early in the Winter, and extend upwards over the whole pool, and as this will be largely composed of packed ice, a considerable increase in slope is inevitable. The drowning out of the rapids will, in itself, greatly reduce the formation of frazil and anchor ice, especially the latter, which does not readily form in water over 25 or 30 ft. in depth. Yet, in the stretch of open water from Prescott down, a considerable quantity will still form especially during periods of severe cold. This will lodge beneath the rough ice cover already formed, and will still further reduce the pool level at the lower end. Whether this reduction will or will not exceed the amount allowed for is difficult to say, but that it will occur every year is certain. On the other hand, the back water from jams starting at the head of Lake St. Francis will no doubt be considerably reduced though not by any means entirely prevented. A certain amount of slush ice will still be formed in the open water below the dams and power houses at all times, and in the beginning of the Winter before the ice cover in the river has permanently formed, there will be a period during which the conditions are particularly favorable to the formation of anchor ice or frazil, all of which will pass on down to begin the formation of the jams below. In any case, the fixing of the pool level at an elevation which will entail the permanent sacrifice of between 100,000 and 200,000 h.p., Summer as well as Winter, whether by reason of the unavoidable Winter drop in pool level, or the flooding of too much land or the risk of depending on so many long and high embankments, is undoubtedly a very serious feature of this method of development.

DOUBLE STAGE DEVELOPMENT.

The essential difference between this method and the single stage development is that instead of the regulating dam at Morrisburg, there will be a combined control and power dam, and a power plant of about 620,000 h.p. operating under a head of 28 ft. There will be a Barnhart Island power house in about the same location but with a pool level of 210 instead of 231. The river improvements as far down as the head of Ogden Island are identical. At that point the navigation channel continues down the present main river channel North of this island, instead of following the Little River channel on the South side, as in the single development. This other Little River at one time carried about 10% of the total flow, but has been closed by a dam for many years.

The main dam is between Ogden Island and the North Shore, and, in addition to a section of free spillway, is provided with a set of Stoney sluices and a number of submerged sluices for Winter regulation. There is a second shorter regulating dam between the lower end of the power plant and the South shore.

The two power houses are in line with each other and parallel to the general direction of the flow, which

is the best possible arrangement as far as the avoidance of ice troubles at the plant are concerned. The over-all length is about 4,300 ft., sufficient to accommodate 66 units of 11,000 e.h.p. capacity. Plans are being worked out, however, at the present time, to employ units of about double this capacity which will considerably shorten the over-all length and improve the lay-out in other ways. The lock, No. 9, will be located at the North end of the main dam, and will have a lift of 28 ft.

Extensive channel improvements will be made between Morrisburg and Barnhart's Island to obtain the required navigation depths and velocities, but this will be largely at the upper end of the stretch. At the lower end the location of the main dam and the power houses will be substantially the same as in the single development, though they will be much lower, as the head at the power plant will be 55 instead of 75 ft. There will be practically no dykes or embankments, and no power house at the head of the Long Sault, nor will there be any necessity for the long and high retaining wall between the North end of the power plant and Sheek Island.

Lock No. 7 and the river improvements below will be exactly as in the single stage scheme, but the canal will be located at the Eastern end of the pool North of Sheek Island, from which the line of navigation will follow the main channel of the river to Morrisburg.

At the double development power house at the foot of Barnhart Island, it is proposed to maintain a constant forebay level of 210. The lay-out in Fig. 9, shows two power houses with a dam and ice sluices about 800 ft. in length separating the lower ends. As shown they have a total length of 3,100, designed to accommodate 50 units each of a capacity of 25,000 e.h.p. This power house can be supplied by the channels on both sides of Sheek Island.

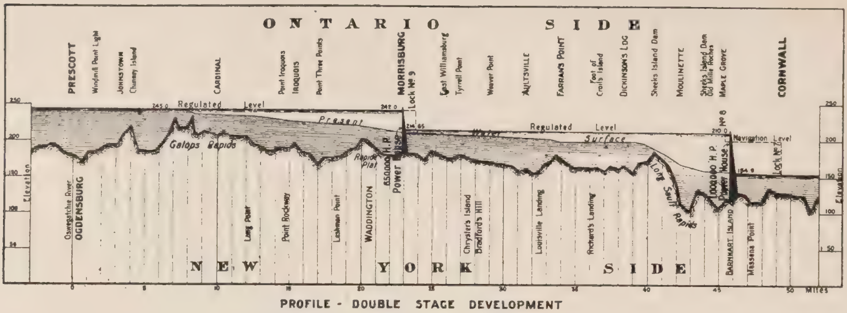
The profile (Fig. 9a) shows that in the double development the pool levels conform fairly closely to the natural profile of the river, the principal increase in height being at the power houses which are at the foot of the rapids. In other words, this method of development is in harmony with the actual physical conditions, and as a consequence the river as a rule does not overtop its present banks. Such flooding as there is, will be almost all above the Morrisburg plant where it will be exactly the same as in the single development.

With regard to ice effects there is a decided difference between the two methods. Down as far as Morrisburg, and below the Barnhart Island works, the water-level conditions under both methods will be the same at all times; and in the beginning of the Winter before the lower pool of the single development freezes over, there will be practically no difference anywhere. But from Morrisburg to the head of the Long Sault the natural level is raised so little in the double development, that navigable velocities are secured in many places only

Fig. 9—Proposed Double Stage Morrisburg-Cornwall Development

by enlarging the channel. Hence, this portion of the river will remain open as at present so far as the main channel is concerned, but the bordage ice will probably extend further out and cover a relatively greater area.

As has been stated before, the drowning out of the rapids, and the deepening of the main channel will



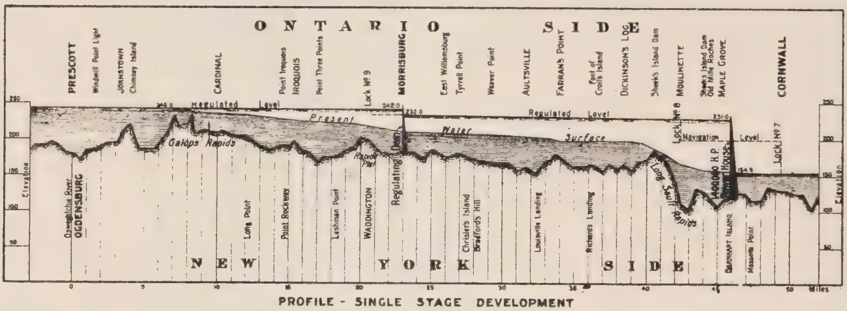


Fig. 9a—Profile Double Stage Morrisburg-Prescott Development

Fig. 8a—Profile Single Stage Morrisburg-Prescott Development

greatly diminish the formation of the anchor ice and frazil; but, with the continuous open channel throughout the pools which will be maintained under the double development, the quantity which does form will in part accumulate under the ice in the bays and eddies, but largely, no doubt, will be carried on downstream to the river below Barnhart Island, and assist in the formation of the jams which cause backwater. On the other hand, special observations, which are confirmed by the regular Winter gauge readings, show that the bordage ice has little effect on the slope of the river. Hence, whatever loss of head may result from the action of ice in the double development scheme, will be largely due to backwater. This will of course be much less than under present conditions and in some years will be almost negligible. The gauge records show that it will never be felt in the tailrace to any great extent until late in January after the peak of the power demand has passed. Furthermore, there is undoubtedly an important element of security in the fact that the accumulations of ice which cut down the power are formed in the river below the plant instead of in the pool above.

The development schemes as outlined in the foregoing must for the present be considered as tentative only.

ESTIMATE OF COST PRESCOTT TO CORNWALL.

Estimates of cost of the entire navigation and power works in this stretch were made by the Hydro-Electric Power Commission of Ontario on the assumption that they would be carried out as one continuous series of operations. This was done in order that they might be directly compared with those of the government engineers which were made on that basis. Based on 1921 conditions, the total estimate for the single development was a little less than $210,000,000, and for the double development about $1,500,000 more. Making allowances for the omission of certain items, the government estimate for the single development (the only one considered), would be about 12% lower, largely attributable to differences in one or two of the unit prices adopted.

A tentative apportionment of the total cost of each of the schemes to power and navigation was made by the Ontario Hydro-Electric Power Commission on the basis of charging to each project the full cost of works required exclusively for its particular purposes, and of dividing equally between the two, the cost of such works as would serve the purposes of both. On this basis, the part chargeable to navigation was about 33% for the single development and 27% for the double development. Other estimates were made by the Power Commission of the cost of carrying out the works, more in accordance with the probable conditions and requirements, all of which indicate a comparatively low cost per h.p. year or per kw. hour.

POWER AVAILABLE.

The quantities of power available at the different sites, which have been mentioned in the foregoing pages, refer to 24-hour power which could have been depended upon year in and year out for practically the whole period of observation. Considering, however, the extraordinary regularity of the flow, and the magnitude and diversity of the power demand in the extensive distribution systems with which these plants would be connected, the power which can be developed and utilized commercially at its full value may be fairly estimated as 20% greater than the figures given. This means that the potential power of the St. Lawrence is not far from 5,000,000 h.p. and of this about four-fifths belongs to Canada.

Nowhere else in the world is there a group of closely associated powers of such magnitude and so advantageously located. Close to the two largest cities, the greatest ocean port, extensive industrial and mining areas, they are actually within transmission distance of half the population of the country. The adjacent districts are served by the principal railway lines, and water transportation is available to the centre of the continent and to all parts of the world. Under such incomparably favorable conditions, the mere development of this power at low cost will in itself attract industries of all kinds, and especially

those requiring hydro - electric energy in large quantities, with reasonable assurance of an adequate future supply.

The development of this power for sale outside the country would not only be of practically no general benefit, but would be virtually giving away almost the whole of its potential value to competitors for the sake of a profit on the bare cost of production, which cannot but be paltry in comparison; and, what is worse, it would involve giving away with it part of the population to boot, which is the last thing Canada can afford to do. Impressive but unmistakable testimony as to this is furnished by the numerous towns and villages located all over New England wherever water power has been until now available, many of which are in large part French Canadian in population, and in all of which there are large French Canadian communities.

While water power in itself is one of Canada's most valuable resources, it has an added importance from the fact that it is essential to the development and profitable exploitation of many of her other rich natural resources upon which she depends for her future prosperity. Wisely developed, and utilized in the country where it belongs and which needs it all, it is not only a great Canadian asset, but, taking into account, for example, the special opportunity which the development and utilization of the great St. Lawrence power offers to the scientist, the engineer, and the industrialist, it may well be regarded as an asset of value to the Empire.

Electric Heater Causes Fatal Accident

Home Made Devices Likely to be Dangerous

ON November 16, in Toronto, a young girl was so severely burned by an electric heater that she succumbed to her injuries on the following day. At the time of the accident she was standing near the heater and her skirt touched an exposed red hot coil and was ignited.

The accident was investigated by the Laboratory, and it was learned that the heater was evidently of a home made type. An old heater of a type (now obsolete) in which large frosted bulbs were used as heating elements, had been rebuilt so as to support two removable coils similar to those now used in reflector type heaters. These coils were screwed into threaded metal shells and mounted in such a manner that both shells and coils were completely exposed. Thus a perfectly harmless device was transformed into a dangerous piece of equipment, capable either of causing electric shock from the exposed "live" parts, or of inflicting severe burns as in the case of the unfortunate victim of this accident.

Advantage may be taken of this accident to warn the public against

the careless use of electricity and particularly against the use of home made devices. "Every man his own electrician" is an unsafe motto. Electricity when properly used is one of the most harmless servants of the modern household, but its use must be safeguarded by proper construction of equipment. Inferior materials and poor design will introduce hazards. It is of course impossible to make anything completely "foolproof" and this statement applies with particular emphasis to electric air heaters of the type under discussion. In order that the heat may escape quickly the hot coil must be exposed to the air and thus a hazard is introduced since inflammable material may be ignited by it. However, this hazard may be reduced to extremely small dimensions by placing a suitable guard around the heating element.

The work of safeguarding the user of electricity is one of the activities of the Commission. The law of Ontario requires that all electrical devices must be approved by the Hydro-Electric Power Commission before being offered for sale in the Province. The Commission has prepared Rules and Regulations providing for the testing and inspection of such devices and the Approved Laboratory is entrusted with the enforcement of these rules. Samples of all electrical devices are subjected to severe tests in the laboratory to determine whether they possess defects in design or construction which will introduce undue hazard in their use by the public. When such defects have been removed the device is approved by the Commission for sale in Ontario. This inspection includes all devices likely to be used by unskilled persons, and by the cooperation of the Commission and the manufacturer in this work, a safe standard, of construction is maintained. Only approved devices are manufactured and sold in Ontario.

Accidents such as that described while very regrettable, should not lead the public to the conclusion that electricity is dangerous. The obvious moral is to reduce the probability of accident to the minimum by using only approved devices, such as are offered for sale by all reputable dealers.

A.M.E.U.

Candidates for Offices for 1925

On the Election Ballots to be submitted at the Convention of this Association on the afternoon of January 28, 1925, the following names will appear as candidates for the various offices:—

PRESIDENT: V. S. McIntyre.

VICE-PRESIDENT: C. E. Schwenger.
R. H. Starr.

SECRETARY: S. R. A. Clement.

TREASURER: D. J. McAuley.
G. J. Mickler.

DIRECTORS: J. G. Archibald.
W. R. Catton.
O. H. Scott.
J. E. Skidmore.
J. E. Teckoe.
P. B. Yates.

Some Requisites of Good Lighting

By PROFESSOR G. R. ANDERSON
University of Toronto

THE first condition of good lighting is obviously to enable us to see properly, therefore the conditions of perfect vision may be laid down as a preliminary.

Conditions of Perfect Vision.

1. Object looked at must be perfectly distinct.
2. It must have sufficient magnitude, real or apparent.
3. It must be sufficiently illuminated.
4. The image must continue on the retina for a sufficient length of time.

Distinctness of Object.

1. Distinctness of object will be secured by:

(a) Simplicity of detail. Any attempt to crowd too much into a given space invariably leads to confusion.

(b) Contrast with the background or suroundings either in shade or colour.

(c) Clearness of the air, cleanliness of windows, etc.

Magnitude of the Object.

2. It must be of sufficient size to be appreciated by the eye at the distance at which it is placed. Small objects must be held close, larger ones may be viewed at a greater distance.

Sufficiency of Illumination.

3. This is not to be confused with sufficient light, there may be abundance of light with very poor illumination. The illumination is on the object viewed, not in the eyes of the spectator.

Sufficient illumination implies:

(a) That the light must be directed on the object;

(b) It must be sufficient in amount;

(c) It must be properly distributed or diffused;

(d) The light must be of good quality;

(e) There must be freedom from glare.

Directing the light on the object may be accomplished:

1. By reflection from mirrors, reflectors of various material or

from the ceiling and walls of the room.

2. By refraction through lenses or prisms.

The amount of illumination required depends on the work to be accomplished. For example:

(a) Street lighting 0.1 to 1 foot candles.

(b) House lighting 3 to 5 foot candles.

(c) Industrial lighting (coarse work), 3 to 5 foot candles.

(d) Industrial lighting (fine work), 10 foot candles.

(e) Industrial lighting (extra fine), 10 to 20 foot candles.

(f) Display lighting 20 and upwards.

As regards distribution, the light must come from a more or less extended source, shadows from a point source such as an arc lamp or even a gas filled lamp will be intense and sharply defined, while those from a source enclosed by a diffusing globe will be soft and luminous.

Shadowless illumination is not in general desirable, so that indirect lighting is not in as great favor as it was some time ago. Spot light effects may be used to emphasize any particular point in conjunction with general lighting.

Good Quality in Lighting.

Good quality in lighting implies:

(a) Freedom from flickering or unsteadiness.

(b) Freedom from radiation injurious to the eye, such as found in the open arc lamp, the quartz mercury lamp, etc.

(c) Color suitable to the work in hand. Most artificial light is redder than daylight which should be our accepted standard, but this is not necessarily an objection. Daylight units should be employed where discrimination of color is required.

Glare.

Glare is the greatest defect in present day lighting. It may be defined as any uncomfortable feeling caused by excessive light entering the eye and so preventing proper perception of the objects looked at as well as doing injury to the eyes. It may be due either to light coming directly from a source or by reflection from a highly illuminated surface.

The following conditions produce glare:

(a) If the brightness of the source of light or the illuminated surface is too great.

(b) If the contrast between the object and its surroundings is too great 100 to 1 gives a glaring condition.

(c) If the bright object is too large.

(d) If the angle between the source and the line of vision is too small. Thirty degrees above horizontal.

(e) If the exposure to any one of the foregoing conditions is too prolonged.

In addition to the foregoing it may be added that good lighting should be attractive in appearance by day or by night and in harmony with the surroundings. It should also be reliable and efficient in

operation. If these conditions are fulfilled in any lighting installation it will be a credit to the man who supplied it and an everlasting joy to the man who owns it.

—*The Electrical Dealer and Contractor*

Ontario Hydro Radio Club Objects and Aims of the Club

To afford opportunity for discussion of radio subjects among members and arrange for talks by authorities on the subject, as well as demonstrations of apparatus by members and manufacturers or vendors.

To encourage the members of the staff to instal receiving sets (especially sets which do not radiate), to advise and assist members in the purchase of sets or parts and in connection with constructing of sets and locating of troubles in their sets, with a view to having them reach the highest possible efficiency. (It is felt that the more advanced members will gladly assist those less experienced.)

To help to promote radio by all legitimate means and co-operate with other organizations having similar objects; to exert all possible efforts to reduce radiation interference.

To assist those who are confined to their home or hospital to acquire receiving sets.

For the Club to broadcast occasionally for the benefit of the staff in Toronto and throughout the Province.

To support the idea of broadcasting by the Commission for the purpose of disseminating information of general interest to the people of Ontario.

IN MEMORIAM

We regret to anounce the death of Mr. Thomas L. McAleese. Mr. McAleese was taken ill with pleuro-pneumonia on December 4th., and passed away on December 9th., at the General Hospital, Niagara Falls, Ont.

Miss C. McAleese, of the Accounts Payable Dept., H.E.P.C., is a daughter and Mr. McAleese's son, Mr. W. F. McAleese, is in charge of Salvage and Stores Dept., at Niagara Development. The late Mr. McAleese was connected with the Hydro Development at Niagara for the last six years, and by his kind and amiable disposition, made many friends amongst those with whom he came in contact. His unexpected death has occasioned deep sorrow and regret among those who knew him and the Bulletin extends its sincere sympathy to Miss C. and Mr. W. F. McAleese in their bereavement.

Hydro News Items

Central Ontario System

The village of Pickering is again asking the Commission for a supply of power and an effort will be made to serve the village as part of the Whitby Rural District. As the capacity of the line between Oshawa and Whitby is limited the service to Pickering will be confined to lighting only. An excellent rural section exists between Whitby and Pickering, many large farms there being owned by Toronto business men.

* * *

A new rural distribution system will be commenced shortly to supply power to the hamlet of Grafton and consumers in Haldimand Township.

* * *

A contract for 200 h.p. has been signed by the Feldspar Glass Co. Ltd., Oshawa. This power is being supplied to the Company for experimental purposes and they propose to operate an electric furnace for the manufacture of ornamental glassware.

* * *

Georgian Bay System

The generators for the South Falls generating station, are being delivered at the site and installation is proceeding. It is expected to have the first of the new units in service before the middle of January.

* * *

Niagara System

The Clinton Public Utilities' Commission have recently purchased an office building situated on the main street.

* * *

A line has recently been completed from Milton to Campbellville. The C.P.R. Railway will take power from this line for pumping purposes at Guelph Junction.

* * *

No. 7 generator, at the Queenston power house was put in operation on the 16th. of this month.

* * *

Three 250 kv-a. transformers have been placed in service in Elmira distributing station, replacing three 150 kv-a. units, which have been removed to Palmerston distributing station for installation there, replacing three 75 kv-a. units at that place.

* * *

Rideau System

The Frost and Wood Factory and the Malleable Iron Works, at Smiths Falls, have started operating after a shut-down of several months.

List of Electrical Material, Devices and Fittings

Approved by The Hydro-Electric Power Commission of Ontario in November 1924.

Appliances

Clear Vision Pump Co. Limited, 510 King St., E., Toronto.

Motor - driven Air Compressors, Model Nos. 432 and 460.

* * *

The Lincoln Electric Company (Submittor), 136 John St., Toronto.

The Peerless Electric Company (Mfr.), Warren, Ohio.

Portable Electric Fans "Peerless."

* * *

The Braun Company, 1515 North 23rd. St., Philadelphia, Pa.

Coffee Grinder, "Coles", Model 48.

* * *

A. G. Milton (Submittor), 67-69 Frederick St., Toronto.

Electric Fires Limited (Mfr.), Norwich, Eng.

Air Heaters, Models Radium II, Radium III, Meridan II, Meridan III, and Meridan IV.

* * *

Southern Electric Company, 107 Richmond St., E., Toronto.

Portable Toaster Stove.

* * *

The Fitzgerald Manufacturing Company, Torrington, Conn.

Electric Air Heaters, "Star", Model C.

* * *

The National Electric Heating Co. Limited, 544 Queen St., E., Toronto.

Electric Flat Irons, Cat. Nos. 105, 105B.

*Spencer Lens Co., 442 Niagara St., Buffalo, N.Y.

Automatic Delineascope, Model 25.

* * *

*Manning, Bowman & Co., Meriden, Conn.

Cooking and Liquid Heating Appliances.

Percolators.

Tea Ball Tea Pot.

Toasters.

Disc Stoves.

Table Stoves.

Waffle Iron.

(As listed on Underwriters' Laboratories card dated September 16, 1924).

* * *

Switches

Duffie Electric Manufacturing Co. Ltd., 1303 Queen St., W., Toronto.

Automatic Switch, Magnetic Type "Cameron".

* * *

The A. B. Ormsby Company Limited (Submittor), 48 Abell St., Toronto.

The Cutler-Hammer Manufacturing Company (Mfr.), Milwaukee, Wis.

Automatic Switches, Machine-operated Type.

* * *

*Paulding, Inc., John I., New Bedford, Mass.

Surface Switches, Single-pole, Cat. No. 22972; Double-pole, Cat. No. 22973; Three-way, Cat. No. 22974.

Flush Switches (As listed on Underwriters' Laboratories card dated September 23, 1924).

Knife Switches, "J.I.P. Inc.", Cat. No. 1500.

* * *

*Allen-Bradley Co., Milwaukee, Wis.

Automatic Switch, Type J-1552, "Allen-Bradley".

* * *

*Industrial Controller Co., Milwaukee, Wis.

Push-button stations for use with automatic switches, "I.C."

* * *

Arrow Electric Co., The, Hartford, Conn.

Pendant Switches, "Arrow", Cat. Nos. 6600, 6602-03, 6679-82 incl., 6700, 6702-03.

* * *

Fittings

A. C. Simmonds, (Submittor), 321 King St., E., Toronto.

N. V. Electrciteits Maatschappij Electrostoom (Mfr.), Rotterdam, Holland.

Wire Connectors "Jasper".

* * *

*Electric Co., The, 94 Allyn St., Hartford, Conn.

Fuseless Attachment Plugs, Cat. Nos. 101, 107, 210.

* * *

*Paulding, Inc., John I., New Bedford, Mass.

Plug Fuse Cut-out Bases, Cat. No. 1935, "J.I.P. Inc.".

Medium Base Receptacles, Porcelain shell; Keyless, Cat. Nos. 1620, 2757, 2758, 2760, 4109, 9403, 50715.

Medium Base Sockets, Weatherproof, Porcelain, Keyless, Cat. No. 9366.

Weatherproof, Composition, Keyless, Cat. No. 43309.

Receptacles for Attachment Plugs, Cat. Nos. 8010, 1438, 1440, 1444, "J.I.P. Inc.".

Fuseless Rosettes, Cat. Nos. 2500-02 incl., 2550-52 incl., 2693-94, 2696, 2755, 4203-05 incl., "Paulding".

* * *

*These devices are under the Underwriters' Laboratories Label or re-examination service.

INDEX TO VOLUME XI

THE

BULLETIN

VOL. XII NO. 1.

Hydro-Electric Power Commission of Ontario

JANUARY 1925

Niagara Gorge, Showing Queenston-Chippawa Generating Station

HYDRO MUNICIPALITIES

CENTRAL ONTARIO SYSTEM

	Pop.
Belleville	12,243
Bloomfield	550
Bowmanville	3,447
Brighton	1,375
Camden East Twp	2,982
Cobourg	5,459
Colborne	829
Darlington Twp.	3,407
Deloro	298
Deseronto	1,928
Havelock	1,266
Kingston	22,368
Lakefield	1,146
Lindsay	7,840
Madoc	1,078
Marmora	853
Millbrook	733
Napanee	2,992
Newcastle	619
Newburgh	434
Norwood	711
Omemee	557
Orono	700
Oshawa	12,246
Peterboro	21,790
Pickering Twp.	4,382
Picton	3,189
Port Hope	4,567
Richmond Twp.	1,944
Seymour Twp	2,506
Stirling	778
Trenton	5,881
Tweed	1 268
Wellington	850
Whitby	4,131
Whitby Twp.	1,785
Whitby E. Twp	3,747
Total	142,879

ESSEX COUNTY SYSTEM

Amherstburg	2,820
Canard River	50
Cottam	333
Essex	1,753
Harrow	619
Kingsville	2,010
Leamington	3,864
Total	11,449

EUGENIA SYSTEM

Alton	450
Artemesia Twp.	2,316
Arthur	1,218
Brant Twp	
Chatsworth	326
Chesley	1,803
Derby Twp.	1,507
Dundalk	690
Durham	1 622
Elmwood	350
Flesherton	417
Grand Valley	595
Hanover	2,842
Holstein	285
Horning's Mills	350
Kilsyth	
Kincardine	2,156
Kinloss Twp	
Lucknow	918
Markdale	927
Meaford	2,406
Mount Forest	1,825
Neustadt	444
Orangeville	2,503
Owen Sound	12,360
Paisley	749
Priceville	
Ripley	670
Shelburne	1,075
Tara	597
Teeswater	807
Wingham	2,470
Total	44,678

MUSKOKA SYSTEM

Gravenhurst	1,621
Huntsville	2,316
Total	3,937

NIAGARA SYSTEM

	Pop.
Acton	1,742
Agincourt	
Ailsa Craig	535
Alvinston	659
Ancaster	400
Ancaster Twp.	4,124
Aylmer	2,241
Ayr	796
Baden	710
Barton Twp.	6,742
Beachville	503
Belle River	580
Bertie Twp.	
Beverly Twp.	
Biddulph Twp.	1,640
Blandford Twp.	
Blenheim Twp.	
Blenheim	1,528
Blyth	692
Bolton	656
Bothwell	630
Brampton	4,406
Brantford	32,786
Brantford Twp.	7,301
Breslau	500
Brigden	400
Brussells	872
Burford	700
Burford Twp.	3,886
Burgessville	300
Caledonia	1,308
Caradoc Twp.	
Chatham	15,525
Chingnacousy Twp.	
Chippawa	1,099
Clifford	
Clinton Twp.	
Clinton	1,941
Comber	800
Copetown	230
Courtright	425
Crowland Twp.	
Dashwood	350
Delaware Twp.	
Delaware	350
Dereham Twp.	3,200
Dorchester	400
Dorchester S. Twp	1,436
Dorchester N Twp.	
Dover E Twp.	
Drayton	602
Dresden	1,393
Drumbo	375
Dublin	218
Dumfries N. Twp.	
Dumfries S. Twp.	
Dundas	5,054
Dunnville	3,569
Dutton	870
Easthope N. Twp.	
Easthope S. Twp.	
Ekfrid Twp.	
Elmira	2,400
Elora	1,199
Embro	463
Etobicoke Twp.	10,463
Exeter	1,458
Fergus	1,815
Flamboro W. Twp.	
Flamboro E. Twp.	2,624
Ford City	5,113
Forest	1,386
Georgetown	2,554
Glencoe	779
Goderich	4,287
Grantham Twp.	3,456
Granton	300
Guelph	17,922
Galt	13,332
Hagersville	1,271
Hamilton	120,235
Harriston	1,326
Harwich Twp.	
Hay Twp	
Hensall	687
Hespeler	3,059
Highgate	403
Howard Twp	
Humberstone Twp.	
Ingersoll	5,422
Jarvis	480
Kitchener	23,027
Lambeth	350
Listowel	2,571
Lobo Twp.	
London	61,639
London Twp	6,073
Louth Twp.	2,312
Lucan	614
Lynden	622
Markham	941
Markham Twp.	
Merlin	
Merritton	2,589
Milton	1,900
Milverton	1,029
Mimico	4 187

THE
BULLETIN
Published by
HYDRO-ELECTRIC POWER COMMISSION
of Ontario

190 University Avenue
Toronto

Subscription Price $2.00
Per Year

The Power Situation

By Sir Adam Beck, Chairman, Hydro-Electric Power Commission of Ontario

IN giving a brief comment upon some of the outstanding features of the work of the Hydro-Electric Power Commission of Ontario during the past year, I may commence by stating that when the returns from the municipalities are completed and analyzed it will, I believe, be found that the year 1924 has been one of marked success, and in many branches of the work there will be substantial surpluses. The seventeenth annual report of the publicly owned electrical undertaking of the municipalities of Ontario for 1924 may, therefore, be anticipated with the assurance that it will be a source of special satisfaction to all concerned.

The electrical service given through the Commission to rural dwellers will have a far-reaching influence upon the economic life of the Province. It is already a factor of great importance. Agriculture still ranks as the most important of Provincial activities, and in these days, with farm labor relatively scarce and costly, anything that lightens the heavy manual farm labor is obviously a great help to the farmer, for, as is universally acknowledged, upon him in the last analysis rests the prosperity and welfare of the community.

Apprehensive of Acute Shortage.

I cannot let this occasion pass without again expressing the very grave concern felt by the Commission and by its administrative officers respecting the very rapid absorption being made of the supplies of electrical energy available from those sources already under development. No one is better circumstanced to appraise the electrical needs and demands of the people of the Province as a whole than are the officers of the Hydro-Electric Power Commission. They are daily in close touch with all phases of the electrical situation. In giving the public the warnings which I have expressed during the last few years that we are approaching a very serious shortage of electrical energy, I have been guided by a judgment based upon an intimate knowledge of all governing factors—a judgment,

CONTENTS

Vol. XII. No. 1

JANUARY, 1925

moreover, that has been confirmed time and again by past experiences.

URGES ST. LAWRENCE DEVELOPMENT.

In addressing the Belleville Board of Trade in February last, I took occasion to review the whole situation, demonstrating how a serious power shortage would doubtless materialize in 1926, and urged the sympathetic co-operation of all interests concerned to facilitate the earliest possible development by the Commission of the St. Lawrence power in the international portion of the river.

At the Queenston-Chippawa plant, seven units are now installed, and the load on this plant has already reached 375,000 horsepower. The eighth unit is being installed, and unit number nine is on order for delivery at the earliest possible date, and is expected to be in operation by the Fall of 1925.

CRITICS ARE PROVEN WRONG.

There is no doubt that those misrepresentations made within the last few years by those who publicly attacked the work of the Commission, and who belittled the Queenston-Chippawa development, contending that its magnitude was far in excess of what any probable demands could justify, have done the Province of Ontario a very serious injury. Such propaganda against the work of the Commission, especially during the period within which the equipment was being installed in the Queenston-Chippawa plant, and its output marketed, exerted a most unfavorable influence on those who otherwise would have thrown the weight of their influence and effort to further the much-needed development of the water power in the international portion of the St. Lawrence River. Everything that the Hydro-Electric Power Commission could do to nullify the effect of misrepresentations that have been made was done.

TRYING TO AVERT SHORTAGE.

The Hydro-Electric Power Commission, notwithstanding the serious handicaps placed upon its efforts on behalf of the development of the St. Lawrence River, has by no means been allowing the menace of a power shortage to remain without doing everything possible to avert it. While steadily continuing its representations with regard to the advisability of developing the St. Lawrence River, the Commission has been furthering its plans for the construction of a steam-electric plant. In this connection, however, the Commission has a very difficult problem, because the value of an investment in such plants depends in large measure upon what additional supplies of hydro-electrical energy may become available in

the early future from the unusual portion of the water power of the St. Lawrence or the Niagara Rivers.

There is now a wholesome optimism abroad in the general commercial and industrial world, and this optimism seems more justifiable than at any period since the conclusion of the war. Recently The Globe, in an editorial, stated:

"It is agreed among economists and financiers that the world is turning the post-war corner and that it is at last getting its feet upon solid ground."

The same editorial concluded that:

"There are unusual tendencies which are bringing Canada, as normally the leading wheat-producing country and the possessor of the greatest water powers anywhere in proportion to population, into a unique economic position. It is a time for robust Canadian faith and enthusiasm."

Now, in order that industry in the Province of Ontario may be able to take full advantage of the returning tide of improved commercial, industrial and general economic conditions, it is necessary to have available adequate supplies of electrical energy for power purposes. That is, for example, a great field for commercial expansion in the production of small electrical equipment for industrial, municipal, domestic and other uses that will be greatly crippled in operation, and certainly in expansion, if the electrical energy necessary for supplying such apparatus and equipment cannot be delivered.

In the future, as in the past, the "Hydro" municipalities of the Province of Ontario will press forward just as rapidly as obstacles impeding progress can be removed.

—The Globe

Water Power Development In Canada

By J. B. Challis, Director, Water Power and Reclamation Service, Ottawa

(*Extracts from Paper read before British Association for the Advancement of Science, Toronto, 1924.*)

CANADA is indeed fortunate in the nature, extent and the location of her power-producing resources. Water power is available in every province. It is most bountifully supplied in the central provinces where the need is greatest, whilst the other provinces possess almost unlimited resources of usable coal. These resources of power assure beyond peradventure a continuous and progressive industrial development. Water power is one of the chief natural advantages of the Dominion, and its development may, without exaggeration, be termed one of the romances of engineering industry.

Historically the development of water power in Canada may be divided into three periods, the first before 1895, the second from 1895 to 1910 and the third subsequent

to 1910. Incidentally it is of interest to note that the two last visits of the British Association to this country in 1897 and 1909, mark very closely the times of change in these periods of development.

The first period, that prior to 1895, may be described as the period of mechanical application of water power. Developments were almost wholly confined to small installations in connection with grist mills, saw mills, paper mills, etc., although with the introduction of the electric generator in the late eighties, a few towns situated immediately adjacent to water falls secured electric power at generator voltage—as, for instance, the city of Ottawa, where electric power was produced and sold about 1890. On the whole, the individual installations during this period were small and at the end of 1895 the total for the whole Dominion did not exceed 75,000 h.p.

Hydro Power Introduced.

The second period from 1895 to 1910 may be described as the "Introductory Period of Hydro-Electric Power." The year 1895 signalized the completion of the first high tension electric power transmission system in Canada and incidentally in the British Empire. This was an 11,000 volt line carrying power from a 1,200 h.p. plant on the Batiscan River, Quebec, to the city of Three Rivers. Similar systems rapidly came into operation in the following years throughout the Dominion; Montreal received power from Lachine in 1898, from Chambly in 1901, from Shawinigan Falls in 1903 and from Soulanges in 1906; Quebec City from Montmorency Falls in 1898; Hamilton was served with power from De Cew Falls in 1898; Niagara plants in Canada came into operation in 1904, 1905 and 1906; Fort William, Ontario, was served from Kakabeka Falls in 1906; Winnipeg, Manitoba, from the Winnipeg River in 1906; Calgary from the Bow River, 1909; Victoria, B.C., from the Gold Stream Plant in 1898; Nelson, B.C., from the Kootenay River in 1898, and Vancouver, B.C., from Coquitlam-Buntzen in 1904. By the end of the second period hydro-electric power had been introduced into the principal cities of Canada and the total water power installation had grown to 880,000 h.p.

The third period, the interval subsequent to 1910, may be decribed as the "Intensive Period of Hydro-Electric Installation." The benefits and advantages of hydro-electric power having been well demonstrated, a great acceleration in the utilization of water power commenced about the year 1910 and has continued up to the present with only a slight retardation during the war period. It may now be stated that every centre of population of importance in the Dominion, excepting only a few cities in the prairies, is served with hydro-electric power and the total water power installation at the beginning of 1924 had grown to the figure of 3,227.000 h.p.

During approximately the last

decade in Canada while the population increased 22%, the water power developed increased nearly 100%, the use of water power in industry, 245%, and the capital invested in manufacturing industries, 175%. Not only was there large growth of purely Canadian manufacturing, but 700 branches of United States factories have been established in Canada and the manufactured portion of Canadian exports, which was 11%, is now 39% of the whole.

The water power now developed in Canada amounting to almost three and a quarter million horsepower represents, including transmission and distribution, a capital investment of $688,000,000. Despite the continuous development that has taken place in the past and the 900,000 h.p. of new construction now in hand, the demand constantly exceeds the supply and it is estimated that some $300,000,000 of additional capital will be needed to meet the actual power demand of the next 10 years.

The water power available, ordinary minimum 24 hour continuous power, is over 18,000,000 h.p., equivalent to an ultimate installation of some 40,000,000 turbine horse-power under present conditions of load factor and will, therefore, provide for a tremendous expansion in the industrial life of the Dominion. Furthermore, this water power is distributed so that it is available near all the centres of population from Coast to Coast except small areas in Southern Alberta and Saskatchewan which have large coal resources available.

Financial Stability of Companies.

The sustained, and in many cases increased earning power of existing hydro-electric undertakings, both publicly and privately owned during the period of post-war vicissitude, has been reflected by the financial standing of the securities of these concerns. The manner in which these securities have stood the strain of general depression and deflation is reflected in the readiness with which capital can be obtained for extensions and new developments when these are properly sponsored.

The capital invested in water power development, transmission and distribution, has grown from $121,000,000 in 1910, to $688,000,000 in 1923, or nearly 500%, and it is estimated that it will reach $1,000,000,000 within the next ten years.

The rapidity of hydro-electric expansion in Canada is very largely the result of the financial showing made by the leading public utility companies which have acquired the reputation for stability of capital and regularity of dividend desired by the conservative investor. The justification for such reputation is found in the ranges of prices of the stocks and bonds of these companies and of their dividend payments during the past 12 years.

In 1921 of the total capital invested in Canadian water power 68% was held in Canada, 6.4% in the United Kingdom, 13.6% in the United States and 12% in other countries. The large proportion of

home capital evidences the substantial support accorded this class of investment by the Canadian investing public.

The development of water power in Canada is no longer speculative, but has become a highly specialized art and is recognized as such by leading financial houses and by individual investors all over the world and particularly in the Dominion. The openings for further investment in Canadian hydro-electric enterprises are numerous; the varied resources of raw material are exceptionally abundant; labor conditions are stable; the total manufactures and the proportion of manufactured exports show rapid and sustained increase; for legitimate power projects governmental co-operation is constructive and positive; the next few years will, therefore, see a large increase of foreign investment in the Canadian water power industry.

Current Process in Dominion.

The period of high and uncertain construction costs current with war-time conditions is definitely passing. Works which a few years ago would not be undertaken by contractors except on a cost plus basis, can now be met by simple inclusive tender. Labor problems are stabilizing themselves. The power industry has established its capacity to manufacture cheaply and market its wares profitably under trying and exacting circumstances. There seems little to impede and much to encourage increased development.

The importance of water power to Canada can hardly be exaggerated. It has brought about and will continue to produce a national prosperity far in advance of anything which would have been possible without its assistance.

The water powers of Canada are administered by seven different governmental authorities according to the province in which they are situated. These are as follows:

The Parliament of Canada in Alberta, Saskatchewan, Manitoba, the Yukon and Northwest Territories. Also water powers on Indian lands, where the underlying title is in the Crown in the right of the Dominion, and those resulting from the construction of public works or the expenditure of public money thereon.

The Legislative Assembly of the respective provinces in British Columbia, Ontario, Quebec, New Brunswick, Nova Scotia and Prince Edward Island.

Production of Low Cost Power

The production of low cost power is sought to be attained.

(1) By the development of power sites and the transmission and sale of power at cost by commissions appointed by certain of the provincial governments, acting under legislative authority and financially supported by the credit of the province.

(2) By the granting of power privileges to municipalities, companies and individuals, on reasonable terms, but under government control and subject to charges for the privileges granted.

The former policy is predominant in

Ontario, New Brunswick and Nova Scotia. To a less extent in Manitoba; the power commission of that province having directed its energies more towards the transmission and supply of power, rather than to its generation.

The latter policy is adopted in the other parts of Canada.

The following is a brief outline of administrative policy and agencies throughout the Dominion.

DIRECT STATE AID.

No direct state aid is given to water power development in Canada, either by subsidy or by tax exemption. In some cases municipalities give assistance to industrial and power developments by granting free sites, exemption from local taxation or a fixed assessment for a term of years, as an inducement for industries to become established within their boundaries.

INDIRECT STATE AID.

Indirect assistance is given in a variety of ways, of which the following are the most important:

1. The Meteorological Service of Canada (including Newfoundland and Bermuda) under the Department of Marine and Fisheries, publishes monthly records of pressure, temperature, humidity, cloudiness, wind (velocity and direction), precipitation and evaporation. Information is supplied free of charge.

2. Survey of the surface water supply of Canada, conducted by the Dominion Water Power Branch of the Department of the Interior, publishes the results of the survey and hydrometric data in four series of annual or biennial reports which deal respectively with Atlantic drainage South of St. Lawrence River, including Nova Scotia, New Brunswick, Prince Edward Island and South-eastern Quebec; St. Lawrence and Southern Hudson Bay drainage in Ontario and Quebec; Arctic and Western Hudson Bay drainage (and Mississippi drainage in Canada) in Alberta, Saskatchewan, Manitoba, extreme Western Ontario, and Northwest Territories; and Pacific drainage in British Columbia and the Yukon Territory. These reports are supplied free of charge.

These two agencies supply the fundamental data which is essential to all water power developers, and the information which is gathered is equally available for public and private enterprises.

3. Indirect assistance to the production of low cost water power is also given by most of the governments in other ways, as follows:

In Alberta, Saskatchewan, Manitoba, the Yukon and the Northwest Territories, licenses for the use of waterpowers are granted by the Minister of the Interior under modern regulations, in which special attention is given to security of tenure and protection of capital invested. Government control over water-power development is complete and direct.

Applicants for a license may be permitted to make use of plans and other information in the possession of the Department of the Interior.

Preference may be given to an application by a province or a municipality.

Stream regulation works may be undertaken for the benefit of licensees.

The regulation of public utilities

operating under Dominion license is provided for either directly by orders of the Governor-in-Council or by referring such matters to provincial public service commissions, such as are now established in Alberta and Manitoba.

The policy of the Dominion government is to encourage the development of the water powers by private or municipal enterprise, and that government has not undertaken any development work. In Manitoba there is a power commission which has built several transmission systems, buying power in bulk and selling it to municipalities and others. It also generates a small amount of power for sale. Saskatchewan and Alberta have not yet undertaken any such works.

In British Columbia the right to the use of water for power purposes is acquired by license issued by the Comptroller of Water Rights under reasonable conditions as to security of tenure, but without definite provision for renewal or compensation. Government control of the right of use is complete and absolute.

The requirements of a municipality may be given preference over those of a private licensee.

The regulation of rates charged by public utilities operating under a license from the province, and to some extent of service, is performed by the Board of Investigation under the Water Act.

All developments have taken place under private or municipal ownership.

Public Ownership in Ontario.

It is a settled policy in Ontario that all the more important power resources of the province should be developed and the power transmitted for distribution by a system of public ownership and operation carried out by the Hydro-Electric Power Commission. Nearly all the settled parts of the province are now receiving power from this commission, the operations of which are on a very large and continually increasing scale.

The development of water powers belonging to the Crown by private enterprise is not encouraged, except such as are to be used for private industrial or manufacturing purposes.

In such cases leases are issued covering the use of the water-power by the Minister of Lands and Forests for a maximum term of forty years (inclusive of possible renewals) and without definite provision for compensation at the end of the term.

When a water privilege is applied for by a municipality a lease may be granted on special terms and conditions.

Water powers may also be owned and operated as a right incidental to riparian ownership.

Government control of water-power developments is thus not absolute, although very nearly so, as all works for holding back water require to be approved before being constructed, and the Hydro-Electric Power Commission, besides being able to acquire any private development, may be authorized to order improvements and alterations to any such development. New works constructed or extended also require to be approved by the commission, and they may determine the quantity of water which a riparian

owner is entitled to use, subject to arbitration.

The regulation of public utilities is performed partly by the Railway and Municipal Board and partly by the Hydro-Electric Power Commission.

Water Powers in Quebec.

The water powers of Quebec which belong to the Crown are leased by the Minister of Lands and Forests, usually by auction, on conditions which are determined so as to be suitable to the individual features of the power site under consideration, and which are generally speaking just and reasonable. Although at the end of the term of the concession the permanent works constructed by the lessee become the property of the Crown without compensation, the term is usually long enough (it averages seventy-five years for the larger power sites) to enable the lessee to amortize their capital cost.

Water powers may also in certain cases be developed and used by riparian owners as a natural right affirmed by legislation, but all works in water which affect public or private rights other than those of the owner must be approved.

Government control of water power development extends to most of the power sites in the province, including those on Crown lands which are still undeveloped and those which are leased for development purposes. A considerable number, however, have passed to private owners, but if these are still undeveloped, an authorization from the Crown for that purpose is generally necessary to avoid litigation.

Besides the favorable conditions under which power sites are leased, very valuable indirect encouragement to the production of cheap power by private enterprise is given in Quebec by means of an extensive system of storage dams and regulating works to increase the dependable flow of the principal power rivers.

These works are carried out under the supervision of the Quebec Streams Commission and the total cost of them will eventually be repaid by those making use of the increased flow, although the credit power of the province is used to secure the money with which they are built.

Public utilities are regulated by means of the Public Service Commission.

New Brunswick Power Commission.

The development and operation of the principal power sites in the province and the transmission and sale of power, under the New Brunswick Electric Power Commission, has been undertaken in that province. It appears probable that government ownership and operation of power resources will be carried out on an extensive scale.

Water powers may also be developed by riparian owners, subject to approval of all works which hold back water.

There are a number of power sites which still remain vested in the Crown, but no regulations have yet been made for disposing of them to be developed by private enterprise.

Government control of water power development is practically complete, owing to the present policy of government ownership, which enables the power commission to acquire any power sites or developments in the pro-

vince, and the necessity of private developers having their works in water approved.

Public utilities are regulated by a board of commissioners appointed for that purpose.

Situation in Nova Scotia.

Nova Scotia has also adopted a policy of public ownership and operation of the principal power sites in the province and has already constructed works of considerable importance.

The property in and the right to the use of all water and water courses in the province, except small and unimportant ones, is declared by law to be vested in the Crown. Consequently all present and future uses of water require to be authorized in order that they may be legally continued or acquired.

Authorizations for the use of water for power and other purposes are granted by the Governor-in-Council on reasonable terms, suited to the individual requirements of the grantee.

Government control of water power development is thus completely effective.

Public utilities are regulated by a Board of Commissioners of Public Utilities.

Prince Edward Island.

The water powers of Prince Edward Island are all of small extent and no laws have been passed with reference to water power administration or development.

All developments have taken place by owners of riparian lands, ownership of which carries with it the right to the use of the flowing water for power purposes.

This right of use is subject to the similar rights of other riparian owners, and to the public rights of navigation and floating where such could be exercised.

There is no board or commission in Prince Edward Island for the regulation of public utilities.

Copper Wire Rod Rolling Mill At Brockville

In September, 1924, the first electrolytic copper wire bar manufactured in Canada, from copper mined and refined in Canada, was rolled in the first copper rod rolling mill ever operated in Canada. This was accomplished through the enterprise of the Eugene F. Phillips Electrical Works Ltd. in building a copper rod rolling mill at Brockville, Ont., and of the Consolidated Mining & Smelting Co. Ltd. in establishing a copper refinery at Trail, B.C.

Until the completion of the Phillips' rolling mill at Brockville, all electrolytic copper wire rods used in Canadian wire mills were imported from one or another of the 18 rolling mills in the United States. At first the Brockville rolling mill imported American wire bars, but now all-British wire and cables can be manufactured

Exterior View of Mill Building

in Canada. Lawford Grant, managing director of the Phillips Company, states that so far as the ore is concerned, the Trail bars appear to be equal to the wire bars supplied by any of the twelve refineries in the United States, or by refineries in England or Australia.

In the Budget of 1923, the Dominion Government, in order to encourage the refining of copper in Canada, established a bounty of 1½¢ per pound for copper wire bars manufactured in Canada from copper produced in Canada, and sold for domestic consumption and not for export. The first bounty earned was on a shipment that left Trail, on August 16, 1924, consigned to the Phillips' mill at Brockville.

Brockville Mill Most Efficient.

The rolling mill at Brockville is of interest not only because it is the first plant of that type to be operated in Canada, but also because it is undoubtedly the world's most modern and efficient copper rod rolling mill, operating with less manual labor per ton of output than the rolling mills in any other country.

The plant at present consists of the mill building, a pump house and a transformer house, although additional buildings such as cable plant, etc., are planned. The mill building is 300 ft. long by 100 ft. wide, clear span, and is of steel and brick construction. The roof, of saw-tooth design, is constructed of reinforced gypsum, with glazed lights facing approximately North and affording even distribution of light. The sides and ends of the building are glazed steel sash from 4½ ft. above the floor to the line of the truss beams, which are 20 ft. above the floor line.

The floor is of reinforced concrete, designed for a load of 600 lb. per sq. ft., except at the North end of the building, where wire bars are stored, this part of the floor being designed for a load of 2,500 lb. per sq. ft. Cast-iron plates are laid at both sides of the roughing mill, and steel plates in the two looping pits.

Billet-Heating Furnace.

The billet-heating furnace is just South of the wire-bar storage space and West of the center line of the building. This furnace is of the W. S. Rockwell Co.'s manufacture, and has a capacity of 120 wire bars. It is oil fired, with two burners, using air atomization. The fuel oil used has a low sulphur content and a gravity of 28 to 30 deg. Beaume. Oil storage is provided by a 15,500 gallon tank placed underground, outside the build-

ing, and the oil is fed into the furnace by means of a small motor-driven centrifugal pump.

FROM BARS TO WIRE.

The wire bars are brought into the plant on electric trucks. They are stacked by an electrically driven overhead crane. When feeding the bars to the furnace, this crane picks them up in batches of ten and places them on skids at the loading end (North end) of the furnace. As required they are fed in by a compressed-air ram, pushing forward the bars already in the furnace, which slide on water-cooled skid pipes.

The bars now being used are about 52 in. long, of rectangular section (about 3¼ by 5¼ in.) and average about 250 lb. in weight, although it is intended that in the near future bars of considerably greater weight will be rolled. Cadmium copper and bars of other special composition are heavier.

A 250 lb. bar of electrolytic copper rolls into a quarter of a mile of ¼ in. round rod. Two such bars—or a half-mile of ¼ in. rod—can be drawn into enough 40 gauge wire to reach from Montreal to Vancouver; 40-gauge wire being 0.003145 in. in diameter, weighing 0.1578 lb. per mile. (It is of interest to note that this wire is enamelled and sold for radio and telephone work with a guaranteed overall diameter of only 0.004in.)

A heated bar is drawn from the furnace and passed into the roughing mill every minute, so, with the 120-bar furnace capacity, it takes two hours for each bar to pass through the furnace, which is approximately 40 ft. long. From the furnace to the roughing mill, the hot bars are transported by tongs suspended from an overhead trolley and guided by the roller-man in charge of the roughing mill.

ROUGHING MILL.

The roughing mill, which is immediately South of the billet-heating furnace, consists of two stands of rolls, three high, the rolls being 18 in. in diameter by 54 in. long. The first stand is used as a breaking-down mill, while the second stand is used either as an intermediate mill or for rolling flats.

In rolling ¼ in. rod, there are nine passes through the roughing mill. The first is the box pass, then square and oval alternately, finishing as oval.

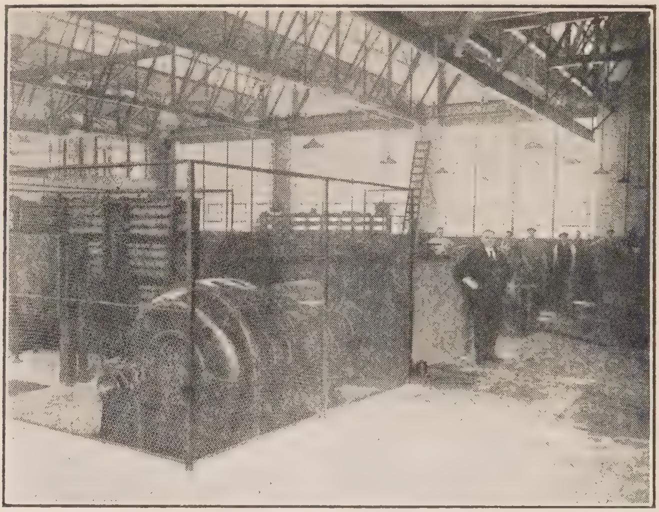
FINISHING MILL.

The finishing mill, which is South of the roughing mill, consists of nine stands of rolls, two high, the diameters of the rolls ranging from 9 to 14 in. The nine passes through the finishing mill start with square and alternate between square and oval until the last pass, which is from oval to round. Round rods are rolled in any size from ¼ in. to 1⅛ in. diameter, the sizes grading by sixteenths of an inch. Flats are rolled from ¾ by ¼ in. to 3½ by ½ in.

LOOPING PITS.

Perhaps the most spectacular feature of the operation of the plant is the work in the two looping pits. There is one of these pits on each side of the finishing mill, providing a surface on which the rod can run from the rolls while the end is being inserted into the next stand of rolls. In case of a jam

Finishing Mill, with North Looping Pit in Foreground



Motor Drive of Finishing Mill

or of a break in the rod, the whole remainder of the rod—which may be of any length up to even 1,000 or 1,300 ft. —curves and twists into the looping pit. The dexterity with which the men "snake" out the hot rod in smooth broad loops that permit it to be drawn through the rolls again at the high speed at which the mill constantly runs, invariably arouses the admiration of all visitors.

The looping pits extend the full width of the finishing mill, and are 90 ft. long on the North side and 66 ft. long on the South side. They are laid on a slope of 1 in 6. Below the upper end of the looping pits are settling tanks into which drains the water from the scale pits under the mills. These tanks are constructed with a series of baffle walls to allow the settlement of any scale carried through from the scale pits.

It is of interest to note that when the finished rod runs from the last pair of rolls in the finishing mill, it is travelling at a speed of 1,300 ft. per minute. It is coiled on automatic pouring reels driven from the mill shaft at the same speed as the finishing pass. On these coilers hydraulic pressure is used for applying the brakes and for raising the coil up to the level of a steel conveyor, 4 ft. wide by 12 ft. long, which carries the coil to a quenching tank 5 ft. deep, and drops it in. The coils fall into a second conveyor, 7 ft. wide by 20 ft. long, which runs through the tank, and which delivers the coil, after three minutes' immersion, on to a small portable platform that has capacity for ten coils. This portable platform, when loaded, is picked up by an elevating electric truck that carries it to Gurney automatic weighing scales and thence out to the shipping platform and directly into the railway car. As soon as one portable platform is removed from the end of the conveyor, another is wheeled into place.

Electrical Equipment.

The whole of the equipment is electrically driven, power being supplied by the Hydro-Electric Power Commission of Ontario at a pressure of 44,-000 volts. The average load for 1924 amounted to 875 h.p. The transmission line runs through the company's property to the transformer house, which is situated about 400 ft. North-West of the mill building.

The transformer equipment, manufactured and installed by the Canadian General Electric Co. Ltd., consists of three single-phase 500 kv-a .44000/2300 air-cooled transformers, controlled by a K-36-8A oil circuit breaker, manually operated.

The lightning arrester is a C.G.E. oxide-film outdoor type, and is installed outside the building in a fenced enclosure.

Static Condensers.

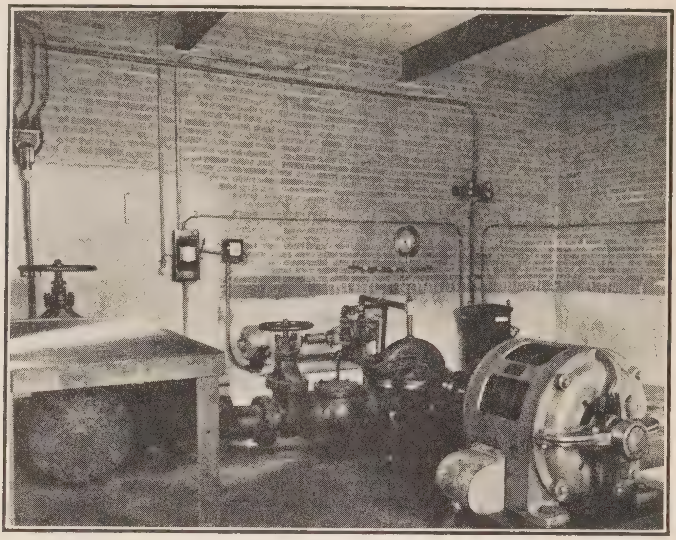
An interesting feature in the transformer house is the installation of two static condensers, of 150 and 270 kv-a. respectively, manufactured by the British Insulated & Helsby Cables Ltd. Power being sold by the Hydro-Electric Power Commission on a basis of 90 per cent power factor, it is important to maintain a high power factor on peak loads. Various methods of improving the power factor were considered, and a decision was made in favour of static condensers, which have proved entirely successful in keeping the power factor above 90 per cent.

Power is transmitted to the mill and pump house by means of Phillips 2,200-volt armoured underground cables, which are tapped outside the mill to feed a bank of 2200/550-volt transformers, which supply 3-phase 550-volt power for driving all small motors in the mill.

Driving Motors.

The roughing mill and finishing mill

Transformer House



Pumping Plant

are driven by 3-phase 2,200-volt induction motors of 500 and 700 h.p. respectively. These motors were designed and manufactured by the Canadian Westinghouse Co. Ltd., of Hamilton, Ont., and are equipped with starting resistances in the rotor circuit which are cut out in three steps, with the exception of a small percentage which remains in circuit under running conditions. The motors, which run at 600 r.p.m, are direct connected to the mill through helical reduction gears supplied by the Falk Co., of Milwaukee, Wis.

Lighting Equipment.

Lighting is effected by 200-watt lamps, arranged in circuits of four across the mill under each sawtooth, giving a spacing of 25 by 25 ft. and affording an even distribution over the whole floor. Lighting current at 110-volt single-phase is obtained from a 2200/110-volt transformer on the pole structure outside the mill. A stand-by supply is provided by the municipal steam plant.

Water Supply.

The water supply for the whole mill is provided by a DeLaval centrifugal pump driven by a 100-h.p. 3-phase 2,200 - volt 1,800 - r.p.m. Crocker-Wheeler motor, direct connected. This pump has a capacity of 1,200 gal. per min. against a total head of 190 ft.

The pump house is located on the bank of the St. Lawrence River and was designed to be in keeping with the surroundings, which, being situated at the foot of the Thousand Islands, possess considerable scenic beauty.

The intake pipe extends about 250 ft from shore, and is a 16 in. cast-iron pipe with flexible joints. It terminates in a screened crib approximately 10 ft. below mean water level.

The discharge pipe from the pump house to the mill is 12 in. cast-iron. The laying of this pipe necessitated cutting a road from the main highway

through an outcrop of very hard granite, which was put through a crusher as removed and provided over 2,000 cu. yd. of broken stone for the concrete foundations for the mill.

Roll-Turning Facilities.

Among the auxiliary equipment in the mill building is a roll-turning lathe, by means of which the grooves in the rolls are cut or renewed as required. The lathe is driven by a variable speed d.c. motor, the rolls being transported on an overhead trolley running from each mill. Current for this motor is provided by a motor-generator, which also supplies the current for charging the batteries of the electric trucks.

The Market In Canada.

The rated capacity of the mill is 120 tons per day, or 720 tons a week. The present consumption in Canada is about 260 tons a week, of which the Brockville plant is rolling approximately 80 per cent. From 1910 to 1914 the consumption in Canada averaged about 340 tons per week. During the war this was greatly increased, of course. —*The Canadian Engineer.*

Courtesy

IT seems such a little thing and still it does so much;—costs nothing but brings in such sure and substantial dividends that the wonder is we so often overlook it. We allow petty irritations to disturb our poise and that in turn warps our sense of justice and we greet our next caller as though he or she were responsible for our unfortunate frame of mind,—and then these parties having caught the infection, go out and pass it on to those they meet. It is startling to consider the possible daily spread of a single discourteous act or word spoken in the morning.

The following letter recently received by a local Hydro Commission from a consumer who had received a peremptory notice of disconnection will be read with interest,—

"To whom it may concern,

"A bit of advice, sweetness and tact go farther than coarse hard brutality in business. High and mighty manners are unbecoming in democracy.

"We have no recollection of any account for the last two months. All other bills have been paid promptly on receipt. For some reason this has been overlooked.

"A peremptory notice of almost immediate disconnection as the first intimation of non-receipt of money is to say the least Prussian method and to be discountenanced. Another such will call for drastic action.

"Here is your money. If you must have the keen relish of writing such letters, kindly discriminate as to the type of person deserving such overbearing procedure. There may be a criminal class that require bailiff method, but do not make the mistake of imagining everyone is of the same type. It involves the sender in such case.

"Better keep the public kindly toward what is now a cumbersome system of keeping accounts.

"Cheer up."

It is but natural that a consumer who had always paid his bills promptly should take exception to a letter threatening dire penalty for an offense of which he had no knowledge, and of which he was not guilty, if his claim not to have received any bill is correct.

Courtesy would seem to require a nicely worded notice of failure to pay a bill which would give the consumer a chance to remedy the omission or offer an explanation, and until this is done, any peremptory notice is premature. In every case an examination of the consumer's ledger card should be made, which will show the consumer's record and is an almost infallible guide as to how the present collection should be handled.

Radio Interference

By Professor A. M. Wilson, University of Cincinnati

(Paper read before the Annual Convention of the Ohio Electric Light Association, Cedar Point, Ohio, July, 1924, and published by permission of the Author.)

WITH the increasing interest in radio reception, and the development of extremely sensitive receiving circuits, there has been an increasing number of complaints of noise which interferes seriously with the enjoyment of radio broadcasted programs. A number of magazine articles have discussed this subject, and not infrequently the trouble has been ascribed to defective power circuits and apparatus. The next step, of course, was to blame the local power company for any sort of noise in the receiving circuits and a good many of the popular radio magazine experts have not hesitated to lay emphasis upon the various ways in which power circuits and equipment might cause disturbance.

Recently an assembly of radio fans suggested an amendment to a bill presented to Congress HR No. 7357—providing that the Secretary of Commerce take steps to eliminate or minimize radio interference due to electrical apparatus. Also, recently, when a certain city was considering the installation of a series arc street lighting system, the local radio enthusiasts protested against such an installation, on the ground that it would interfere with radio reception.

Of course, radio enthusiasts are not the only people who go off half cocked, and undertake to solve problems, which are not clearly understood, by means of legislation, but the only remedy for any of the many forms of agitation based on ignorance is education. And in order to arrive at the correct solution for any problem, it is necessary to get the facts and give them proper consideration. It is necessary, also, to let the people know that the facts are being collected and considered, with a view to determining how best to solve the problem and serve them.

The N.E.L.A. recognized the necessity for giving thorough consideration to the complaints of radio inter-

ference, and a sub-committee of the committee on inductive co-ordination was organized early in 1924 to make a systematic study of the subject and report from time to time. On this sub-committee, in addition to representatives of a few operating companies, there are representatives of the Radio Corporation, the General Electric Company, and the Westinghouse Company.

If radio interference is investigated in a thorough manner, it will be necessary for the operating companies to furnish information regarding the complaints which come to them, and how they meet them. If the experience of a large number of companies is brought to a central clearing house, and if each company can, through this pooling of experience, have the benefit of the work of all the other companies, a great deal of time and effort can be saved.

We can start with some thoroughly established facts. First, we are agreed that atmospheric electricity is the most important source of noise. We know that a disruptive discharge will radiate energy. Even the very small arc due to poor contact on switch blades, has been known to cause radio interference. We know also, that part of the radiation from a sparking commutator, or a violet ray machine, or a leaky insulator or transformer bushing, can be propagated along the connecting wires, much as carried current is propagated. And it is quite apparent that radio interference problems must, in general, be solved by the use of radio. There may be conditions occasionally where it is possible to locate the source of disturbance by switching operations or by inspection or from data regarding the time of the disturbances, but generally it is necessary to use radio methods and equipment to locate the actual source of interference.

From the information so far available, it does not seem feasible for power companies to accept, at their face value, all complaints of radio interference which come to them. Most companies have all they can do to give satisfactory service on equipment and circuits for which they are directly responsible. But there are certain characteristic types of radio complaints which indicate clearly that the power circuits or service facilities are out of order, and these complaints should be treated as very important sources of information, from the service standpoint, as well as the standpoint of public relations.

Starting with the conditions which brought about the formation of the committee, and with a body of general principles upon which all were agreed, the committee attempted first to collect detailed information upon which to base its activities. A very simple blank form was sent to a number of companies which had been more or less active in following up some of the complaints of radio interference they had received. This blank form was for the purpose of finding out; first, what complaints had been received by each company during the previous year; second, what equipment and procedure each company had adopted, in cases where it felt justified in trying to locate the cause of the

trouble; and third, what results had been obtained.

Of course, as was expected, this elementary questionnaire met the usual fate accorded to questionnaires. But sufficient information was made available, by the answers which came back, to give the committee some very definite tasks. The answers indicated at once that there was no general agreement regarding the value of the complaints, the procedure to adopt, or the equipment to use. Even the value of the results obtained did not seem to be clear to some companies.

It was agreed that the results showed that those who complained could be divided into three classes; first, those who did not know enough about either radio or power problems to complain intelligently; second, those whose trouble was due to conditions in their immediate vicinity, for which the company was not responsible; and third, those who had interference due to circuits or equipment for which the power company was responsible. The first and second classes are usually individual cases, or in very small groups, while complaints from the third class usually cover a rather large territory.

Two recent reports are rather characteristic. One from a town in New York State gives the following results: A number of cases of radio interference were found to be due to defective heating pads. There was one case of a sparking commutator on a coffee grinder motor, two defective electric stoves, one grounded fire alarm circuit, and two grounded transformers. The sparking commutator did not affect a test set fifty feet away, while the grounded transformers interfered with practically all the radio receivers in the town.

A report from another operating company covering a rather wide territory, includes the following: Grounded arc circuits located by switching operations, and then the exact sources were located by the hot-cold method. There were grounds on two arc circuits. A 60 cycle hum in radio receivers was cut down when a high tension line was cut out. A defective transformer bushing was located by inspection. A clicking sound in radio receivers was found to be due to railroad crossing bells. A loop set was found to operate satisfactorily beside a noisy set. The trouble was found to be due to a defective C battery. A loose connection in an antenna on an apartment house interfered with reception by neighboring sets, when the set connected to the defective antenna was in operation.

Many more cases could be cited. These are from relatively recent reports, and indicate the variety of the causes of radio interference. In addition to a study of current cases, some experimental work was done by some members of the committee. Some of the results corroborate previous information, others form the basis for future progress. It has been determined that mercury arc rectifiers are not sources of radio interference except during the brief starting period. Voltage regulators, even when they have been in service for years, are not sources of interference. Magnetite arcs do not cause trouble under normal conditions. The carrier effect in prop-

agating radio interference can be stopped by inserting inductance in the leads of the source of disturbance, and connecting capacity across the line between the inductance and the source; but it has not been feasible as yet, to develop these filter circuits for general use on a commercial basis.

With regard to the types of equipment to use in tracing sources of radio interference, it may be said that there is still considerable difference of opinion. But it is generally being recognized that, for such work as tracing down such sources of noise as household appliances or sparking commutators a very sensitive set is essential. For locating such sources of trouble as arcing grounds, or leaky insulators, or transformer bushings, less sensitive sets seem to give best results. Some excellent results were obtained recently by the use of a loop aerial with a thoroughly shielded set, so that the maximum benefit could be secured from the directional value of the loop. In this case the coil aerial is connected to a primary coil in the set, making it aperiodic. The secondary is tuned to a detector, with regeneration, and one tube of amplification is used. It will be seen from this description that sensitiveness has been sacrificed for compass action. Others report satisfactory results by the use of a loop aerial connected directly to a pair of head phones, with one side of the loop connected to the frame of the machine. One case was reported of a man locating a bad insulator by walking along the line with a pair of head phones connected to a light aerial in one hand and a ground rod in the other. In general, however, it may be said that there is no unanimity of opinion or of practice.

It might be mentioned here, that while ordinarily the more expensive and therefore more sensitive sets seem to be most susceptible to stray radiation, on account of their selectivity, they seem to be less affected by radiation from carrier current on power lines than the more elementary equipments.

When the possessor of a radio receiving set finds that it is noisy, there are several things he can do to satisfy himself as to the probable source of the trouble. If he finds upon inquiry that his neighbors have no unusual trouble, he should go over his own set, or investigate possible sources of trouble in his immediate surroundings. If he considers it necessary to complain to the power company, he should furnish, with his complaint, information which may help diagnose his case and save considerable time. If he is not willing to go to some trouble, his case cannot be very serious.

The following questions have been suggested, but it is probable that changes might be made to suit local conditions.

(1) Does the interfering noise have a definite pitch and quality?

(2) Is the noise heard with the same intensity over a wide area or is it stronger in some places than others?

(3) In what other locations, besides your own, does this noise occur?

(4) Is the noise intermittent? If so, indicate at what time it occurs? If it varies in intensity, indicate at what times the variation is most marked?

(5) Does the noise tune in to any particular wave lengths?

(6) What types of receiving equipment are most affected by the interference?

(7) Does anyone near you use electricity for some special purpose, in addition to the ordinary use for light and power?

(8) When was the interference first observed?

This brief statement will probably serve to give a complete enough picture of the general situation so that those who are interested in radio interference will feel justified to co-operate with the committee in carrying on the work which is planned for the future. It is hoped that a little time spent in co-operative effort will, in the long run, result in a saving, both of time and labor.

It will probably be of interest, that a study has been made, to determine the effect of radio upon the use of light and other electrical facilities in the home, indicated that, in the particular community in which the test was made, the revenue per customer increased about 33 per cent after he had invested in radio receiving equipment. From this it seems that the power companies are justified in showing a friendly interest in radio reception, at least to the extent of furnishing information occasionally, which will be of service in lessening their troubles and increasing their income.

CKY and Educational Broadcasting

THE following address was broadcasted recently by D. R. P. Coats, Director of CKY, and received through a loud speaker by the delegates at a convention of teachers in session at the Parliament Buildings, Winnipeg:—

"Ladies and Gentlemen:

"This afternoon we are endeavoring to show you something of the possibilities of radio as an educator and as an aid to the teacher in the school. It is doubtful, I think, if any hobby can compare with radio in educational value. The boy who experiments with radio learns more about the wonders of electricity in its various forms than could be learned by experiment with the batteries, magnets, motors, etc., which used to content the boys of the last generation. In assembling a radio set, the boy becomes something of an electrician, something of a cabinet-maker, and something of a general handy man. When the set is finished and the stations are logged night after night, the boy learns perhaps more about the geography of this continent than could be taught in school in the same length of time. And when he passes through the phase of being a mere station hunter, trying to log more stations than his friends; when he settles down somewhat and pays less attention to the announcements of call letters and more to what constitutes the programmes, then he learns all kinds of information which is likely to be remembered for a long time. If we may speak of ourselves, or rather of our own station, CKY, we may be permitted to say that over two years

ago, we foresaw a change which was bound to come in radio broadcasting, if it was to be established on a permanent and enduring basis. We saw that the use of broadcasting for the mere purpose of purveying musical entertainment involved a waste of tremendous opportunities and could not last. It occurred to us that broadcasting was intended to be used for a higher purpose than this; that its educational possibilities had been sadly neglected in Canada and that, ultimately, education was going to be the backbone of the broadcasting programme. I do not mean, of course, that music was to be dispensed with. Certainly not. Good music is necessary to one's education. Even jazz music has its place among the necessities, though I may shock you by saying so. But all work and no play makes Jack a dull boy, and the lighter forms of music tend to liven up the old world as well as to give us discriminating taste, and, by contrast, a better appreciation of that which is really good.

Having decided to try the experiment of introducing educational features into our programmes on a scale such as had never before been attempted in Canada, we approached the University of Manitoba, through our good friend Professor W. T. Allison, who has been our staunch supporter ever since. Prof. Allison was quick to see our views as we presented them to him, and in a very short time he had made arrangements for a course of weekly half-hour lectures on a variety of subjects to be delivered at CKY during the early part of the evening programme. We met some criticism at first, from parties who accused us of endeavoring to 'uplift' them, but in a little while we had satisfactory evidence that the experiment was proving a success, and that one of its effects was to induce a great many people to become radio listeners who previously had scorned the idea. We have documentary evidence in plenty to prove this, by the way. Then we tackled the Agricultural College and proposed to the authorities there that CKY might broadcast talks to farmers. A delegation of the Faculty promptly came in from M.A.C., and it was not very long before the regular Farmers' Talks were inaugurated—the first of their kind in Canada. The Farmers' Talks have become one of our popular features. Quite recently, we added the Farmers' Question Box and the Household Economic Question Box services. The Farmers' Question Box, according to people in close touch with listeners in the country, is the most valuable feature of all CKY's programmes. As an aid to musical education, the stories of the Grand Operas, with recordings of the finest music by the world's best artists, has proved very popular.

Our later original feature, the 'Half Hours with the Great Composers' series is bringing us a considerable amount of appreciative correspondence. This afternoon we are going to repeat one of the "Half Hours" series—the story of the Life of Gounod. The story will be interspersed with reproductions of some of the composer's greatest works. In a few minutes, also we shall give you an example of another radio feature which originated at CKY—one of the 'Fireside Yarns' series. All this

will help to show you, we hope, something of the educational possibilities of radio. And now I want to urge you to get behind us in making one of our pet dreams come true — the equipment of every schoolhouse in Manitoba with a radio set and loud speaker and the introduction of daily broadcasting from CKY for inclusion in the regular school curriculum. I suggest that when every school is equipped, your most capable city teachers should come to CKY and broadcast instruction which will be heard in every schoolhouse throughout the Province. History, French, English and a number of subjects might be taught this way. As soon as we know that a fair number of country schools are equipped, we shall be ready to cooperate in every way possible with the school authorities. We urge people in every community listening in this afternoon to get their local schools equipped with radio and then to write to CKY. We are opening a register of all such schools and we want the name of your town to appear in it. Our register of radio-equipped schools is open not only to Manitoba communities, but to those elsewhere in Canada as well as to our friends and cousins South of the border. I thank you."

—*Radio News of Canada.*

Presentation to Mr. W. G. Ferguson

Mr. Wm. G. Ferguson, retiring local manager of the Hydro-Electric Power Commission, at Peterborough, was the recipient on Wednesday, December 31st., of a gold watch and chain, accompanied by an address, presented by the employees of the local Street Railway and Gas Departments of the Hydro-Electric Power Commission of Ontario.

The presentation, which took place in the George Street offices, was attended by the entire local staff, and expressions of regret were universal at the retirement of Mr. Ferguson, who has been for the past ten years local Manager, since the absorption of the old Otonabee Power Company, of which he was Manager, into the Hydro system.

Mr. Ferguson in reply, commented upon the pleasant relations which had always existed between himself and his staff, and at his own regret at severing cordial relations of such long standing. He spoke at some length of the friendship he had for heads of all departments, making special reference to Mr. L. G. Ireland, who until recently was General Manager of the Central Ontario System of the Hydro Electric Power Commission.

The following is the address:

"Dear Mr. Ferguson:

"We, the employees of the Peterboro Radial Railway, and the Gas Department, have heard with much regret that you are about to sever your connection with our company. We say with regret, because we are sorry to lose a manager whose relations with his staff have always been of the most cordial nature, but our sorrow is tempered with happiness when we realize that you are about to enjoy a rest to which you are justly entitled by reason of your long and faithful service.

"We shall ever remember with

gratitude your unfailing kindness and courteous treatment, and strive to emulate the loyal devotion to duty that brings you to the end of a long business career with a record of faithful and untiring service. Such a record will undoubtedly prove a pleasant memory during the rest of a life which we trust will be long and happy.

"We ask you to accept this slight token as a souvenir of our regard and of the friendly feeling that has existed between us for many years, with a hope that you will not forget in your more leisurely existence the companions of strenuous business hours."

Yours respectfully,

(Signed) H. L. Beal, J. McCann, W. A. Hinds, S. T. Harris, C. Detcher, C. C. Clark, H. Spargo, E. F. Reid, O. W. Harris, A. Armstrong, H. S. Pogue, F. R. Sanderson, T. J. Montgomery, W. J. Clow, G. R. Quartermaine.

Peterborough, December 31, 1924.

Mr. J. F. Katzenmeier Passes

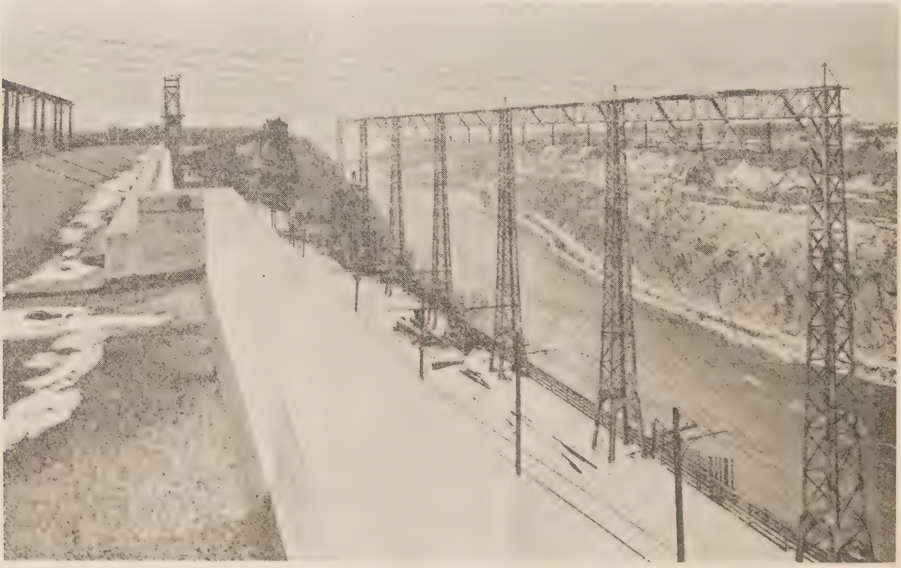
It is with extreme regret that we record the sudden passing of Mr. John Frederick Katzenmeier on the morning of Tuesday, December 23rd., 1924, at his home in New Hamburg. Mr. Katzenmeier was apparently in good health and attended to his duties all day and evening on Monday. Late that evening he was suddenly stricken with paralysis and died about 3 o'clock the following morning without regaining consciousness.

The deceased was one of the most prominent citizens of New Hamburg, and through his kindly and cheerful disposition had endeared himself to a very wide circle of friends.

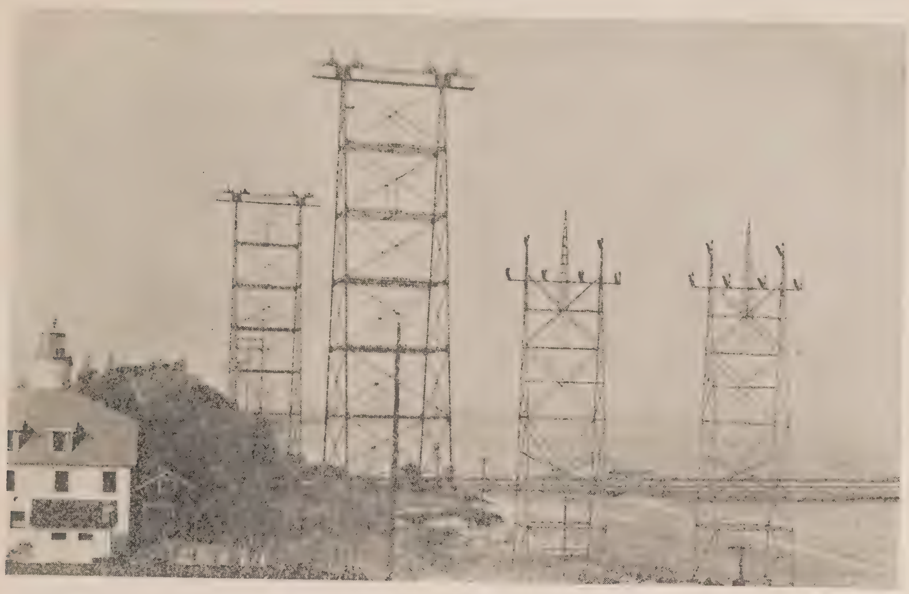
Being born in Columbus, Ohio, on March 5th., 1858, the deceased came to New Hamburg as a child, and there spent practically his whole life. He took an active interest in the affairs of the village, serving in many public capacities. He was a member of the school board for fifteen years, and a member of the village council for ten years, four of which were as Reeve, being Warden of Waterloo County in 1909. Ten years ago he was appointed village clerk. In 1910, when New Hamburg gained the distinction of being the first Municipality to receive electricity through the Hydro-Electric Power Commission of Ontario, Mr. Katzenmeier was appointed Secretary of the local Hydro-Electric Department, which position he held up to the time of his death. He was also Secretary of the Public Library Board.

The deceased is survived by his widow, Catherine Goetz, three sons and one daughter, Earl C., of New York City, Edward J., of Seattle, Wash., Dr. Harry, of Kitchener, and Mrs. Roy Lockhart, of New Hamburg. The Bulletin extends to the bereaved family the sympathy of the officials of the various Hydro Utilities and Commissions.

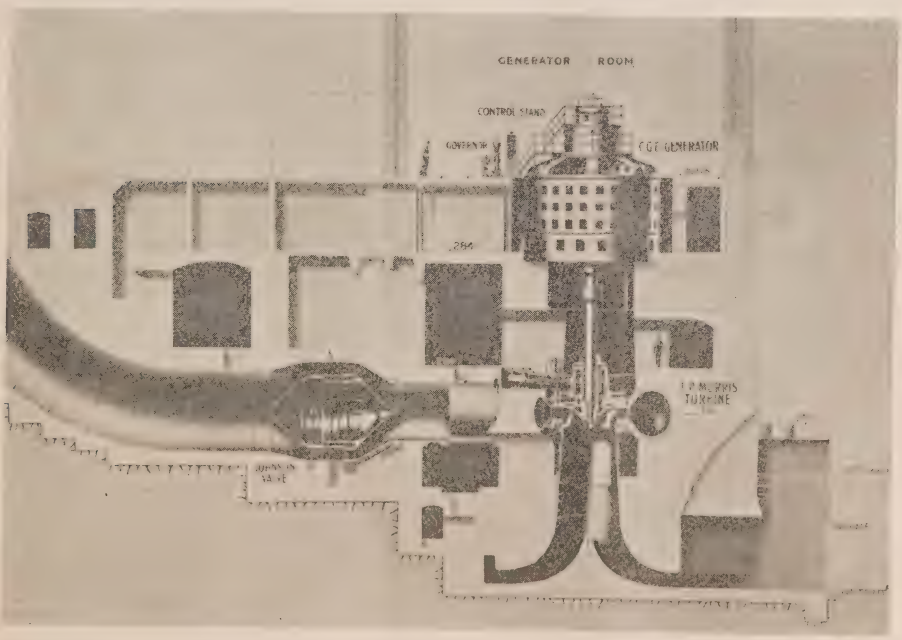
The above view shows a concentration of power at one point which it is doubtful if has ever been equalled. It shows the transmission lines crossing Burlington Beach. On the left is shown the line recently constructed for 110,000 volt transmission from Queenston. The next is the 44,000 volt line of



Queenston-Chippawa Development, view showing the 110 kv. transmission lines at the escarpment.



the Dominion Power and Transmission Company. On the right are shown the four circuits formerly the property of the Toronto Power Co., now Hydro, two of which are operated at 90,000 volts and the other two being 110,000.



Queenston-Chippawa Development, Section through a Generating Unit.

Industrial Heating Furnaces

THE average consumer of electricity has become fairly familiar with the apparatus in daily use and may have some appreciation of the quality of materials assigned to various duties in the devices with the reasons for their selection. It is probable, however, that few persons not closely connected with manufacturing or research realize how thoroughly various parts of the problem have been studied and quite frequently would-be imitators find their progress hampered in many ways due to lack of the proper perspective. In view of these facts it is probable that the following information abstracted from articles by E. F. Collins, in the Chemical and Metallurgical Engineering Journal, June 16 and 23, 1924, on Industrial Heating Furnaces, may be of interest to those who find pleasure or profit in considering such problems.

In problems involving heating by electricity, the successful designer must have information on the materials available and in general along the following lines.

I. Chemical—reactions at low and high temperature, — oxidation, decarbonization at high temperatures,—fluxing of refractories, the effect of furnace atmospheres.

II. Mechanical—Expansion or contraction with the heat—physical strength at low and high temperatures—crystallization at high temperatures—abrasion of refractories when hot—methods of construction.

III. Physical—heat generation, conservation, transmission, absorption, distribution, storage, equalization, emission, potential, diffusion and heat quantity, temperature gradients and control of temperatures.

IV. Laws of environment and psychology involving knowledge of the heating process, shop methods, types of individual likely to act as operators, peculiarities of the product or methods of manufacture. The alertness of executives to improved methods, their progressiveness and the effect on the working conditions for the operators.

V. Economic laws, covering the first cost of the furnace, the operating cost, output for given floor space, reduction in labor, improvement in quality or its uniformity.

It will appear that the method of analysis is applicable to many processes not electrical but the writer's subject being electrical furnaces involves more special attention being given to a few only of the more forceful points. The heat generation is 100 per cent. perfect in metallic resistors and releases 3.412 B.t.u. per kilowatt-hour. Heat conservation is less perfect depending on the construction of walls, floor, roof and doors and the ventilation of the working chamber. Data given indicates that the heat emission from a flat wire is so much better than that from a round wire as to make it superior from the point of economy and safety.

Heat distribution and equalization is governed by convection, conduction and radiation, as well as placing of the heating elements. Proper distribution is facilitated by the use of mufflers and the study of conduction and radiation shows that uniform heating may be obtained with heaters located in groups.

Heat transmission and temperature gradients through materials require careful attention in the design. Fireclay, silica and alundum are the most satisfactory materials for mufflers which require high melting point, must be mechanically strong and be good conductors of heat. Their use, however, necessitates a higher temperature in the resistors and records given, show also that with automatic temperature control the control is effected within closer limits of variation of temperature without the use of baffles.

The author expresses the hope that a better appreciation of the problems of design will result from the discussion given. It is evident that engineering of the highest order is required to solve heating problems of a large scale satisfactorily and it is predicted that it will not be long until electric heating on a large scale for important thermal processes will be adopted with no more hesitation than it now is accepted for household use.

The Minus Quantity

By William V. Fitzgerald

THE minus sign in the mathematical world is only a term. But it has a bigger significance than most people think, for its application to the manipulation of numbers and algebraic quantities is not its most important use. Dollars come and go, as do all the things that men spend time calculating with mathematics. The really important use of the minus sign is its application to the *human* equation.

What is a "minus" sign? As applied to making one's way in the world, it is a quantity or quality which one has developed consciously or unconsciously and which is detrimental to success in one's work. A man does not have to go about placarded with posters showing mathematical signs and symbols to display his positive and negative characteristics. However, the average man *does* go about placarded more effectively than any posters could do the job—placarded in so many different ways, insidious ways, that he himself scarcely feels their presence. There are probably as many different kinds of human "minus" signs as there are human beings.

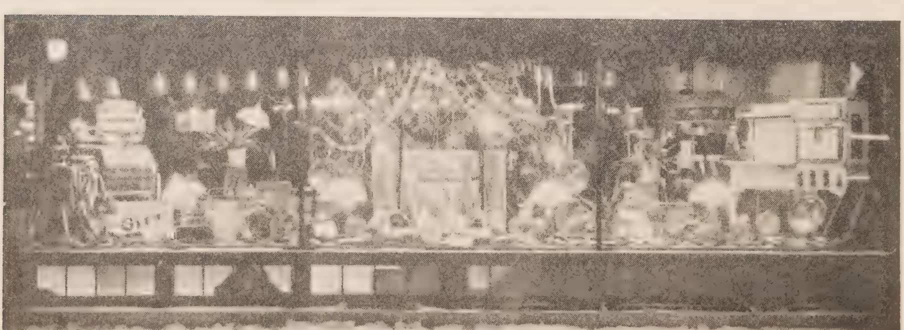
Then there is the fellow who "takes a chance" on something being pretty nearly right or "just about," or "good enough." What an awful handicap that man carries about in his daily work. He grinds in a valve on his engine and instead of working until the valve and seat are in first-class condition, he concludes it's good enough while there are still pit marks in evidence. He puts his engine together and starts it up only to find that the valves again give trouble in a much shorter time than they ordinarily would. He curses his "rotten luck" and performs the whole operation over

again, while men mark him as a man who gets poor results.

A serious "minus quantity" is possessed by the man who has the bad habit of saying he knows when he doesn't know, or of giving some kind of information in the absence of the correct information. This man is a pitfall with a rose garden covering, in any organization. He is the man who will give the explanation of the most profound phenomenon, provided his audience knows nothing of the subject. He has the quick answer and the volume of phrases with which to mystify. He tells you "right off the bat" what the fusing point of cast iron is or what the temperature of steam is at 350 lb. pressure. It takes a little time for associates to get wise to him, but when they do, they usually listen to what he has to say—and promptly consult the handbook or the reference book. This type of man causes a lot of trouble and misunderstanding to others in that sometimes non-technical people who take him seriously become thoroughly convinced of his superior knowledge.

There are two ways to improve one's chances of success. One of those ways is to increase the quantity of factors that are on the positive side of your account — education, experience, interest in up-to-date methods and appliance and other means whereby the number of things one can do well is augmented. The other way to assure success, is to search out the "minus" quantities that have been developed, and to ostracize them rigorously. *Men of talent and brilliance of mind are failures only because they have equally great nullifying characteristics, while mediocre men achieve wonders because they have taken the pains to eradicate their nullifying tendencies.*

—*Power.*



Christmas Display, Windsor Hydro Shop

The Effects of Artificial Light On Plant Growth

An abstract of lectures given at the Convention of the Illuminating Engineering Society, Briar Cliff, N.Y., October, 1924.

Abstracted by Geo. G. Cousins, Asst. Laboratory Engineer, H. E. P. C. of Ontario

CONSIDERABLE interest has been shown regarding the stimulation or hastening of plant growth by means of artificial light. A fairly large amount of research has been expended upon the subject but, being done by different individuals with different incentives, the work has lacked co-ordination, the results have not generally been consistent and definite conclusions could not be formed from the information obtained. Some work has recently been done to determine the effects of artificial light upon plant growth and the results are briefly summarized in the following:

There are several factors contributing to the growth of plants such as atmosphere, temperature, soil temperature, humidity, soil condition, light and probably others of varying importance. In the work described herein, an attempt was made to segregate the effects of light, including its quality or composition, its intensity and the duration of its application.

The subject of this abstract includes two phases of the broad subject under consideration, namely the influence of colored light and the influence of intensity and the length of its application.

THE INFLUENCE OF COLORED LIGHT.

It is fairly well established that the circulation of the sap and the procuring of nourishment is influenced by heat and some species of stimulation by infra-red radiant energy. Visible light also influences the sap movement. The fixation of carbon from the atmosphere seems directly dependent upon light or upon a stimulation akin to light radiations and the development of chlorophyl, that substance common to all green leaves, cannot successfully take place without such stimulation.

No successful growth has been reported or seems possible under cold light, nor can it be assumed that daylight is the ideal condition for plant development.

In the experiments made to arrive at some basis of understanding of the problem, several varieties of flowers and vegetables were grown on the greenhouse bench and in compartments from which all daylight was excluded. In these compartments, 4 ft. 6 in. long by 2 ft. square on the ends, artificial light was supplied by gas filled tungsten lamps as follows: unmodified light from 750 watt lamp, a 1000 watt lamp from which the heat rays were partly absorbed by passing the light through a layer of clear water, and a 1000 watt lamp from which much of the longer waves, red and heat rays, were screened by a special glass.

Control or check plants were grown

simultaneously under normal conditions of natural lighting in the greenhouse for the period of the test, February and March. The average greenhouse illumination during the day ranged from 170 ft. c. on a cloudy day to 1460 ft. c. on a clear day. The greenhouse temperature was held at about 65 deg. fahr., while the average temperature in the compartments was from 75 to 81 deg. fahr. The average intensity of illumination in the compartments equipped with tungsten lamps was 500 ft. c.

It is surprising to note that the speed of growth for those plants grown under artificial light only was about double the normal growth of those on the greenhouse bench. The artificial light was applied for nine hours per day.

Bulbous plants such as tulips, hyacinths and similar plants can be brought into full bloom in twenty days under artificial light alone. The absence of ultra-violet radiation did not seem to retard these plants nor affect the color of the flowers. No difference could be noted in plants grown in the various compartments except that the temperature under the unscreened 750 watt lamp was sufficiently high to slightly retard their best development. Apparently the screening out of the long waves (red and heat rays) was advantageous to plant growth. Unscreened artificial light, however, resulted in richer green leaf colors when the air and soil temperatures were kept low. The conclusion follows that the long wave stimulation is beneficial when the soil and air temperatures are kept within bounds. The accelerated growth under artificial light alone was not materially due to the increased air and soil temperatures as compared to the temperatures of the plants grown in the normal manner in the greenhouse under natural lighting. The constant artificial light stimulation for a period equivalent to daylight and of an intensity approximating average daylight resulted in better growth than the changeable natural illumination.

Further tests were run in order to secure information regarding radiations from different parts of the spectrum and larger compartments were used from which all daylight was excluded. Varieties of plants were grown which were not limited to any particular season. Artificial light was used for approximately 12 hours per day. Five compartments were illuminated respectively, with a clear 750 watt lamp; a 1000 watt lamp screened with glass that is opaque to ultra-violet; a 1000 watt lamp screened with glass partially opaque to infra-red; a 1000 watt lamp screened with glass opaque to infra-red and a 480 watt mercury vapor "M" tube.

Corn failed to survive after 20 days' exposure to blue green glass opaque to infra-red and appeared to need some of the heat rays even though the air and the soil were amply warm. Beans behaved in a generally similar manner under the same light. Geraniums were somewhat better. Plants grown under the mercury vapor were not healthy although in this case the intensity (15 ft. c.) may have been too low. Good growths of beans and corn under unmodified light was produced. Growths under light deficient in violet

and ultra violet rays appeared equally as good as that under unmodified light. Geraniums seemed to do better under light deficient in violet rays.

The unmodified light from gas filled lamps was better than illumination from the same source when the long waves were screened out.

The intensity of illumination from the gas-filled lamps used in this series was 350 ft. c. and the average air temperature was 87 deg. fahr.

Radiation in the region of the red and infra-red waves are beneficial to plant growth provided the soils and air temperatures are properly regulated.

Another investigator studied the behaviour of plants with special reference to the life cycle of the plant which includes the reproductive process.

Seed production is a function of the plant that lends itself readily to research involving the use of artificial light. In plants where seed production is the objective, electric light has been shown to be of value in accelerating growth and hastening maturity. Plants have been matured with no other source than electric light.

The addition of electric light or the shading of plants involves physiological changes in the plant of which little is known.

In the so-called "long day" plants, the addition of electric light has been shown to speed up the reproductive process during the short days, while in the so-called "short day" plants, although the addition of electric light accelerates growth, the reproductive process is retarded. Either the addition of electric light or the cutting down of daylight is necessary to bring about the desired change when plants are forced into seed production out of their regular season. Plants blooming in winter can be made to bloom in mid-Summer by shading while plants ordinarily blooming in Summer can be made to bloom in winter by the addition of electric light.

The life cycle of a plant consists of a steady and uninterrupted growth. However, a plant like head lettuce, an annual, is considered to have two stages of development, head formation and seed production and this offers a more complicated problem.

It was found that even a moderate intensity of from 40 to 84 ft. c. from edge to centre of the plot, used from 4.30 p.m. to 6.30 a.m. the next day produced a much more rapid growth than that under ordinary conditions in the same greenhouse. However the development of the plants progressed through to the seed production without the intermediate stage of head formation, and consequently such plants were not marketable. It was later found that by forcing the plants by artificial light up to a certain stage and then removing the artificial light stimulation, a good marketable head was produced in a much shorter time than was possible under natural light only. The proper control of light stimulation produced good heads with larger leaves than unstimulated plants.

Other varieties of lettuce were tested and some of them found to be better suited to forcing by means of light. About two weeks after the plants were transplanted, the artificial light stimulation was started and applied for a few hours each night until the head formation stage was reached when the use of artificial light was discontinued. This resulted in good marketable heads two weeks earlier than with the check plants grown under normal conditions.

Some tests were run to determine the relation of temperature to light. Three greenhouses were available whose night temperatures were 60 deg. fahr., 55 deg. fahr. and 45 deg. fahr. Similar groups of plants were tested in each. Each test included a box of plants grown by daylight only and a similar which received additional artificial light. Under each temperature the additional light (6 ft. from a 200 watt lamp) increased the rate of growth, but in each case the temperature was the controlling factor in producing marketable heads.

There seems to be no doubt that even low intensities of illumination from gas filled lamps stimulate plant growth and hasten maturity. Too little is known about what happens to the physiology of the plant when stimulated by artificial light. The problem resolves itself into one of manipulation of quantity of light and time of application in order to produce a desired product.

From experimental results obtained to date, it is safe to recommend electric light stimulation where flowering and seed production are the objectives, but where a certain type of growth is desired, recommendations cannot be accurately made until more fundamental research is carried on to determine the changes made within the plant.

One may conclude from the results of the tests described herein that very moderate intensities of electric light intelligently applied can be put to commercial use in the greenhouse production of flowers and certain vegetables.

List of Electrical Material, Devices and Fittings

Approved by The Hydro-Electric Power Commission of Ontario in December 1924.

Appliances

Willard Storage Battery Company Of Canada Limited, 100 Sterling Rd., Toronto.

"Colloid" Rectifier.

* * *

The Frank E. Wolcott Manufacturing Co., Hartford, Conn.

Marcel Wavers, "Eclipse" and "Torrid".

* * *

Renfrew Electric Products Limited, Renfrew, Ont.

Circulating type Water Heaters, Cat. Nos. 25, 26, 28 and 30.

* * *

Sumbling Machinery Company,

LIMITED, 7-15 St. Mary St., Toronto, Ont.
Electric Ironing Machine.

* * *

*CRESCENT WASHING MACHINE CO., New Rochelle, N.Y.
Electric Dish-washing Machines, Models R, MM, AA and EE.

* * *

*HEIDBRINK CO., THE, MFR., 420 S. Sixth St., Minneapolis, Minn.
Electric Heater for attachment to apparatus employed for administering nitrous oxide gas.

* * *

*WILDMAN MANUFACTURING CO., (MFR.), Norristown, Pa.
S. E. BALLARD, (Submittor), 54 Lombard St., Toronto, Ont.
Electric Cloth Cutting Machines, Types D and E.

* * *

Switches

W. PAYNE, 6 Gilholm Ave., Galt, Ont.
Support for Switch Boxes.

* * *

MR. J. GORDON STEISS, 5 Otto St., Kitchener, Ont.
Automatic Switch—Clock-operated, "Master".

* * *

*INDUSTRIAL CONTROLLER CO., Milwaukee, Wis.
Resistance Appliances (as listed on Underwriters' Laboratories card, dated March 24,1922.).

* * *

Fixtures

*CURTIS LIGHTING INC., 1119 W. Jackson Blvd., Chicago, Ill.
Fixtures for use with gas-filled lamps.
Fixtures, Stage Type, "National X-Ray," "X-Ray".
Electric and Combination Fixtures.
Fixtures Fittings (as listed on Underwriters' Laboratories Card, dated May 9, 1924).

* * *

*PITTSBURGH REFLECTOR & ILLUMINATING CO., (Mfr.), 3117 Penn Ave., Pittsburgh, Pa.
WILSON ILLUMINATION COMPANY (Submittor), 83 York St., Toronto, Ont.
Show Window Fixtures.

* * *

*MUTER CO., LESLIE F., 32-34, W. 69th. St., Chicago, Ill.
"Muter" Lightning Arrester.

* * *

*HEINEMANN ELECTRIC CO., 1730 North 5th. St., Philadelphia, Pa.
"Sensory" Lightning Arresters.

* * *

*FREEMAN ELECTRIC CO., E. H., Trenton, N.J.
"Little Joe" Lightning Arresters.

* * *

*JEWELL ELECTRICAL INSTRUMENT CO., 1640-50 Walnut St., Chicago, Ill.
Lightning Arresters.

* * *

*These devices are under the Underwriters' Laboratories re-examination or label service.

THE BULLETIN

Published by
HYDRO-ELECTRIC POWER COMMISSION
of Ontario

190 University Avenue
Toronto

Subscription Price $2.00
Per Year

A.M.E.U. CONVENTION NUMBER

Opening Address

By J. E. B. Phelps, Sarnia, President

ON behalf of the Officers elected by the Association I desire to welcome the delegates to this Convention. I have not yet got from the Secretary the number who have registered at this Convention, but you will remember that last year we had a record attendance at our Winter Convention, and I think you will agree with me that, from the attendance at our luncheon to-day, we are getting away to a good start; and we hope to have a very enjoyable meeting.

This is the first convention we have had after affiliation with the Ontario Municipal Electrical Association; and the affiliation of these two associations should result in strengthening our position and enable us to wield a greater influence for Hydro in this Province.

Personally, I am convinced at this time that we did the right thing in affiliating these two associations. I want to be frank, and confess to you that when it was first broached I was in opposition to it. The main reason for being opposed to the affiliation of the two associations was that I did not believe in the mixing of engineering and the matters of policy; but as there is a resolution to be brought up in regard to the affiliation this afternoon, I think that matter has been cleared away; and I think after joining hands, as I have said, we will have a far stronger organization.

All of you have heard of the power shortage that Sir Adam Beck has been telling us about, that is going to come in the year 1926; and it seems that Sir Adam's prediction is going to be verified.

You remember that a number of years ago, at a banquet held, I think, in this hotel, Mr. Goodwin, of New York, made the statement that as fast as the electrical engineers could develop the power, the commercial end would have it sold. In other words, that the commercial end would keep ahead of the development end of Hydro in this Province. He was

CONTENTS

Vol. XII. No. 2

FEBRUARY, 1925

A.M.E.U. Convention Number

speaking generally, not only of Ontario but of general conditions in Canada and the United States. His prophecy also is being verified. There is no question that we are not having normal conditions at the present time in our Province in regard to industrial life; our factories are not up to their normal production; and yet in spite of that fact, we are going to have a power shortage, because, as you are aware, as fast as the new generators can be installed at the Queenston-Chippawa plant, a load is waiting for them.

I say that as Hydro engineers and managers in our various municipalities, we do not want to go through,—and God help us if we have to,—the same conditions that we had during the War. You men who were in charge of plants throughout the Province of Ontario know the conditions at that time; and if in the year 1926 we have to say to our municipalities, to the industrial establishments and to the people in their homes that we have no current to give them, you can imagine the condition! If that condition arises, the industrial life in this Province is going to be put back a decade or possibly a quarter of a century. We will be playing second fiddle to other Provinces who are allowing their power interests to go ahead and develop their power.

The active competitor, especially for the Eastern Districts, is the Province of Quebec; and you know what is happening down there, that their government is allowing the private interests down there to go ahead and develop their resources; so that if there is any way by which this power shortage can be eliminated or met, I hope that in Sir Adam Beck's speech this evening he will have something to say about it and that we can go from this meeting feeling that the power shortage will not come upon us.

It has come to the point in this Province where the parties in control are paying no attention to these associations. Gentlemen, the time has come when Associations such as these, the Association of Municipal Electrical Utilities and the Ontario Municipal Electrical Association, when they get together and go before a Government to make a request in regard to the Power question, must exert such an influence that when they say something the government will sit up and take notice of what is said.

Whom do these Associations represent? Do you not represent the Municipalities who really own this proposi-

tion? That being the case, then we should have something to say in regard to its management and operation!

Now, just a word about our Programme. I think we have got away to a good start at our luncheon. We had a first-class address from Professor DeLury; and, as you are aware, we are to have with us to-night Sir Adam Beck at our dinner at 6.30; and the committee has made arrangements to have Sir Adam's speech broadcasted, and the gentlemen in charge say that they will make it so loud that the people will have to hear what Sir Adam is going to say. I am sure we are to be congratulated upon the Committee which has been in charge of making these arrangements.

I think you will be satisfied that the various papers which have been provided are interesting and will bring out much valuable information. I hope you will enter heartily into the discussions, and thus bring out the fullest benefit to be derived from the papers to be presented.

I want to thank the Committee who have had the arrangements for the Convention in charge. I am sure they have been and are making a really first-class job of it; and if we do not enjoy ourselves and go home with more information in regard to Hydro matters and better qualified to deal with our problems, it will not be because we have not had the proper training.

Before sitting down, I want to thank you for the honour which you have done me in placing me in the position of your President. I do not know that I have done all that I might have done as President; but, at least, I have been serious in my office and have tried to live up to the high honour which you have placed upon me. I thank you, gentlemen.

The Financial Position of the Hydro-Electric Power Commission for the Year 1924

by Sir Adam Beck, Chairman, Hydro-Electric Power Commission of Ontario

(Extracts from address to Ontario Municipal Electrical Association and Association of Municipal Electrical Utilities, at Toronto, Jan. 28, 1925)

THE Commission has been more fortunate this year in completing its financial statement at an earlier date, owing to the freedom from the annoying interference of investigating commissions. It is gratified in again being able to report, notwithstanding the industrial depression, favourably upon the financial operations and, in fact, is able to advise that the past year has been the most successful in its history. The Commission is able to present a statement which shows that the revenue obtained from the consumers has been more than sufficient to meet

the full cost of generation, transformation and transmitting of power, and to provide for all operating expenses, maintenance and fixed charges, including full sinking funds and depreciation on the new Queenston-Chippawa Development, notwithstanding the fact that the Commission has only received an average of the output of four generators from this plant, but has included in its financial statement the capital charges on the complete canal and six units.

During the Session of the Legislature in 1914 the Act of the Hydro-Electric Power Commission was amended to enable the Commission to incorporate the properties which it is operating at Niagara Falls, as a part of the Hydro-Electric Power Commission's Systems, and to combine their capital costs, including the Ontario Power Company, Toronto Power Company and the new Plant, the Queenston - Chippawa Development. The financial statement submitted by the Commission for the year 1924 will include the total capital share of the Municipalities for all generating costs, in addition to the transformation and transmission costs which have been included in past reports.

During the year 1924 the Wasdell, Severn and Eugenia Systems have been combined for generating purposes, in accordance with the Legislation of 1924, and during the year 1925 the Muskoka System will be included.

With the above mentioned changes and combination of generating systems the total number of systems operated by the Commission will be reduced from 13 to 8, to which are connected at the present time some 386 municipalities including 131 townships and rural districts, being an increase of 30 municipalities for the year 1924, of which 24 were townships and six urban municipalities.

The operating capital investment of the Commission increased in the year 1924 from $167,941,072.12 in 1923 to $187,154,718.92, or an increase for the year of $19,213,646.80.

The capital expenditure of the Commission and the Municipalities by the end of 1924 exceeds $251,000,000.00.

The total revenue collected by the Commission from the municipalities and other power customers for the year amounted to $16,547,491.20. This revenue was appropriated as follows :—

Operation, maintenance, administration, interest and other current expenses, $12,979,024.35; reserved for sinking fund, renewal of plant and equipment, $2,965,731.09; total $15,-944,755.44; leaving a surplus collected in excess of Operating Expenses and fixed charges as above, and which is subject to provision for Contingency Reserve of $602,735.76.

It is estimated that the revenues of the Municipalities will reach the vast sum of $20,000,000.00 for the year 1924, upon which there will be a surplus of $1,000,000.00 after all reserves for sinking funds, contingencies and depreciation have been provided for.

In 1923 the revenue was $17,219,-044.27 upon which the Municipalities had a surplus, after all of the above mentioned items had been taken care of, of $1,093,753.36.

In the year 1923 the reserves of the Commission and the Municipalities, for sinking fund, renewals and contingency purposes amounted to $33,807,234.83.

Although complete information is not yet available for all Municipalities, it is estimated that the total reserves of the Commission and the Municipalities for the above items will reach the sum of $40,000,000.00.

This is a remarkable showing when one realizes that the average period of operation of the Municipalities connected to the Commission's systems does not exceed 10 years and the annual reserves set up in the future will be greater, as the Municipalities all take up their sinking fund charges and the total reserves per annum will soon reach the sum of $10,000,000.00.

The financial statements of the Municipalities and the Commission will show this year that over 60 Municipalities will have quick assets of cash, bonds and accounts receivable in excess of all liabilities, including the balance of their debenture debt, which may fairly be considered as being entirely out of debt.

The estimated saving to light and power consumers over rates in use previous to the commencement of Hydro operations with the Municipalities to the end of 1924, amounts to the huge sum of $140,000,000.00, and is being increased at the present time by an amount exceeding $25,000,000.00 per annum. The Commission's and the Municipalities' Systems serve a population of 2,250,000 people, with over 400,000 consumers.

The following is a short summary of the increase in capacity of the various systems of the Commission:—

Plant Capacity and Output for 1924.

	Operating Normal Capacity Horse-Power	Load Peak Horse-Power	Total Output During fiscal Year, kilo-watt hours
Hydro-Electric Generating Plants.			
Niagara	685,500	620,106	2,526,662,700
Central Ontario	42,675	49,167	140,782,070
Georgian Bay	14,130	13,999	43,449,874
Muskoka	1,400	1,468	5,442,700
Rideau	2,800	3,157	5,418,998
Nipissing	2,940	3,280	7,197,154
Thunder Bay	50,000	34,200	121,925,080
Totals, Hydro-Electric Plants	799,445	725,377*	2,850,878,576

STEAM PLANTS.

	Normal Operating Capacity Horse-Power	Peak Load Horse-Power	Total Output During fiscal Year, kilo-watt hours
Toronto Steam Plant	20,000	——	——

POWER PURCHASED.

	Contract Amount Horse-Power	Peak Horse-Power	Total Purchased Kilowatt Hours
Total purchased by All Companies	45,245	53,811*	150,922,465
Grand total, 1924	864,690	779,188*	3,001,801,041
Grand total, 1923	756,982	756,668*	2,842,416,705
INCREASE			159,384,336
Per cent. Increase			5.6

*Peak totals given are direct sums of plant peaks as shown without allowance for diversity in time. Therefore these totals do not indicate the demands on the various systems where there is more than one plant supplying power.

The important increase in plant capacities during the year were:—

	Horse Power
Queenston-Chippawa Development, Units 6 and 7 - -	110,000
Nipigon System, Units 3 and 4 - - - - - - -	25,000
Dams 8 and 9 on the Trent System - - - - - - -	10,000
TOTAL - - - - -	145,000

All of this increased capacity has been practically taken up by the power demands of the Municipalities.

From the information which the Commission has before it to-day, practically all of the systems will have utilized the complete capacity of the present power developments by the year 1926, and it is urgent that immediate authority be given to the Commission to enable it to proceed with new and larger developments in order to meet this demand of the Municipalities.

NIAGARA SYSTEM.

As previously stated, there has been a continued increase in the demands for power for industrial purposes in spite of the fact that industrial conditions throughout the Province have not yet reached their normal level, and the Commission has considerable anxiety as to the future plans for new developments for the meeting of this growing demand.

The total available capacity of the Niagara System's plants is approximately as follows:—

With seven units installed at the Queenston plant, operating the Ontario Power Company's plant to full capacity and the Electrical Development Company's plant, to utilize the surplus waters, plus 20,000 h.p. purchased from the Canadian Niagara Power Company, the available capacity is from - - 650,000 to 670,000 h.p.

With eight units installed at the Queenston plant operating on the same basis, the available capacity would be from - - - 680,000 to 700,000 h.p.

With nine units installed at the Queenston plant operating on the same basis, the available capacity would be from (1925) - 715,000 to 720,000 h.p.

If ten units are installed at the Queenston plant operating on the same basis, the available capacity would be from (1926) - 750,000 to 760,000 h.p.

The combined peaks of all plants for December of the year 1923 amounted to 611,902 h.p., and for the year 1924 the combined peaks of December were 662,320 h.p., an increase of over 50,000 h.p.

This December peak in 1924 exceeded the previous estimates of the Commission and based upon such estimates for the year 1925, the Commission may expect a peak load in excess of 710,000 h.p., in 1926—765,000 and in 1927— 835,000 h.p.

The above estimated peaks are conservative and with return to normal industrial conditions, will be exceeded to a considerable extent.

The estimated peak loads of 1926, as indicated above, will exhaust all available capacity for 1926, and it will be necessary to provide an additional capacity of from 50,000 to 100,000 h.p. in order to meet the demands of the municipalities in 1927.

In order that the Commission may meet the demands of the municipalities in the future, the Commission, in January 1924, made application for the development of 300,000 h.p. at Morrisburg on the St. Lawrence River, receiving the necessary Order-in-Council from the Provincial Government, authorizing the proceeding with this work. The Commission has been investigating the power developments on the St. Lawrence River since 1923, and has expended upwards of $350,000 upon such work.

In January 1924, application was made to the Federal Government for approval of plans for the construction of the works at Morrisburg and in September of the same year the Commission was advised that the plans had been referred to the Advisory Committee of the Government on St. Lawrence matters.

In addition the Commission made application to the Ontario Government for leases of all the Ontario waterpowers on the St. Lawrence and on the Ottawa Rivers, some 500,000 h.p. being available to Ontario on the Ottawa River. A few of the more important powers on the Ottawa River are:—

Carrillon	200,000 h.p.
Chats Falls	110,000 h.p.
Rocher Fendu	75,000 h.p.
Deux Rivieres	
Deschenes, etc.	175,000 h.p.

In view of the urgency of meeting

the demands for power in the year 1926, it is imperative that the Commission immediately proceed with the necessary plans for the construction of new developments. The only source from which power can be obtained at a date to meet the demands is by the construction of steam plants within the Niagara system.

Application has been made by the Commission for authority to proceed with the construction of such plants, and last year during the 1924 meeting of the Legislature $5,000,000 was voted for this purpose.

It is unfortunate that the Commission should be required to undertake the construction of such plants at this time, and purchase coal from a foreign country to operate the same, when the water power is running to waste on our great International and Interprovincial streams.

The value of the 1,500,000 available h.p. on the St. Lawrence and Ottawa Rivers is equal to from 9,000,000 to 10,000,000 tons of coal per annum or a value of from $50,000,000 to $60,000,000 in generated water power running to waste.

This, capitalized, means from $1,000,000,000 to $1,500,000,000.

Rural Distribution.

During the past year satisfactory progress was made in the extension of electrical service to rural dwellers.

In pursuance of the Government's policy the Rural Hydro-Electric Distribution Act was amended during the past year to provide for the inclusion of the transformers and secondary equipment in the grant of the Provincial Government. The amount of the grant remains the same as when applied to primary lines only, namely, up to fifty per cent. of the cost.

It should be understood clearly that the grants given by the Provincial Government towards the cost of rural electrical service are grants in aid of agriculture and are simply an extension of a well-established policy which has previously found expression in expenditures incurred for agricultural schools and colleges, for experimental farms, for good roads and in other ways. These grants are in no sense for the purpose of assisting the hydro-electrical undertaking of the municipalities.

In order to ensure a reasonable return upon the capital invested in rural distribution lines and equipment, the Commission has, after very extensive investigation, established a standard minimum of three farm contracts, or the equivalent, per mile of line constructed. This is the basis of the application for the grant towards rural lines.

Rural Extensions in 1923.

Miles of line approved................146

Number of consumers — Hamlet 4,059, Farm 960............Total 5,019

Capital approved for primary line extensions $321,102.61

Total Rural Service.

Commission has contracts with 131 Townships.

Consumers now served 20,605; not yet connected 1,950.... Total 22,555.

Miles of line....................1,205 miles

Capital expended..........$2,446,127.73

Government bonus......$1,214,921.14

Power supplied in rural districts to serve Farm, Hamlet, and Rural Power Customers..............7,581 h.p.

It is of interest to note that over two-thirds of the rural mileage has been built and about half the rural consumers have been connected during the last three and one-half years.

An Electromance

Two rival testers met in a magnetic field, and so high was the tension it almost induced a potential difference between them. Suddenly each espied a sparkling volt tripping from segment to segment. Seeing them, she leapt headlong into a rushing torrent.

"Ah, the hapless maid!" cried one, "would a rotary converter?"

"It autotransformer," replied the other.

"Why do you swim so fast?" both called out.

"Because the current is behind me—alas, I am wattless—I mean hapless."

"Oh!" cried the testers.

"Hurry to the Wheatstone Bridge," said one.

"Wattmeter!"

"A-mmeter! But don't run too fast and trip on the breakers."

"Look!"

"Y point?" he delta blow.

"There are fifty cycles; take one and hurry."

"I dare not, it belongs to a policeman."

"That is merely a copper loss."

"Sine wave to her, throw megaline."

The maid was saved, and lay choking with reaction.

One sought to raise her "Impedance"—impudence, I mean.

"I cannot stand this heavy torque," said the tester, "the load on the line is too great, there'll soon be a heavy drop."

"Yet I will rectifier," said the other; "there is my leaky grid, let us seek a field less excited."

"R.M.S.," she lisped, with some reluctance, "say no more, do not make the poor solenoid."

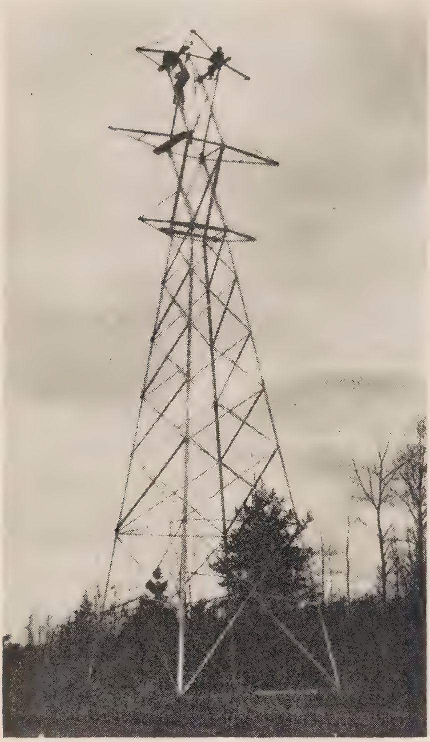
"Is your answer still in the negative?" he asked tenderly.

"I am not positive," she said.

"Fickle maid, you have changed your polarity."

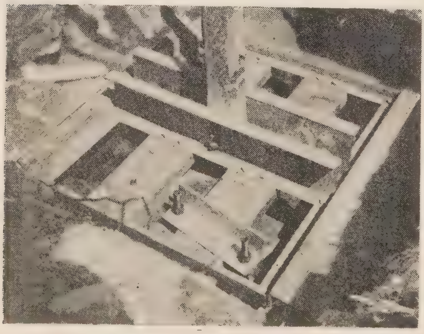
Looking back at his rival, he cried, "You go and kilowatt while I take megohm."

By A. L. Paget, B.Sc. in the Faraday House Journal.



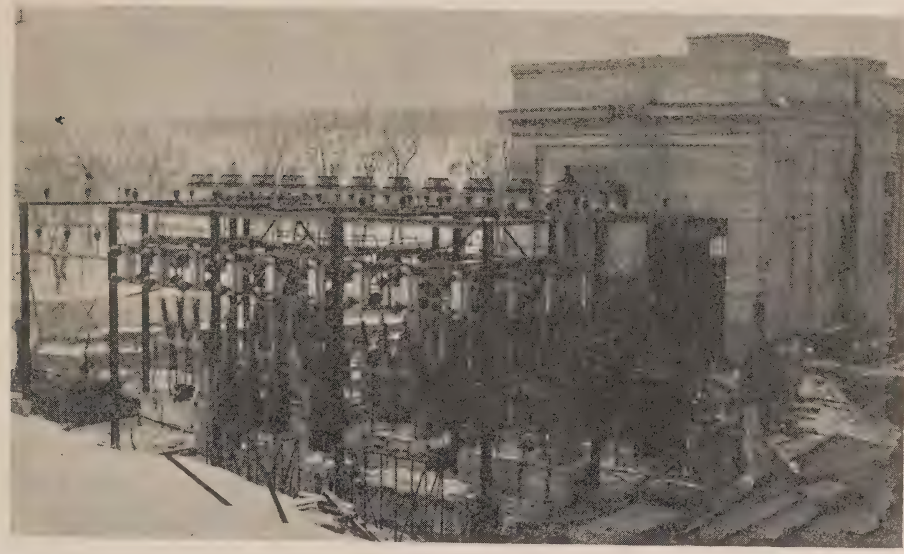
Constructing Blaw Knox type tower, Nipigon Lines.

Rock footing (partial assembly) before embedding in concrete, suspension type, Blaw Knox type tower, Nipigon. Lines.



Rock footing ready for concrete, suspension type, Canadian Bridge Company tower, Nipigon Lines.

No. 2 pipe line, under construction, Nipissing Development, view from headworks.



Outdoor 44000 volt switching and transformer station, Central Ontario System, at Dam No. 9, Generating Station with installation of equipment nearing completion.

Dam No. 9 Generating Station, Central Ontario System, showing tail race cribwork being blown out on Feb. 14, 1925. The first unit in this station is now being dried out preparatory to going into regular service.

Distribution System Engineering

By J. H. Caster, Assistant Engineer, H. E. P. C. of Ontario

(Paper read before Association of Municipal Electrical Utilities at Toronto, January 28, 1925.)

SEVERAL excellent papers have previously been written for this Association on distribution systems, and it occurred to the writer that your Papers' Committee were running short of material when they requested this one. However, the subject will stand considerable discussion, and is always a live one owing to the growth of both the business and the new equipment available for line construction. I was also reminded that the paper was to be on distribution system *Engineering* and from that I gathered that it was not a treatise on digging holes or stringing wire, but something more vague, with possibly an answer as to why we insist on doing all the absurd things that are done by engineers, when some other way would be so much easier.

As this is written for distribution only among Engineers, I shall begin by admitting that engineering is the application of common sense to the problem in hand. (This is not the kind of engineering you once dreamed about which had a salary of $15,000.00 to $20,000.00 a year attached). There is in addition to the first named requisite, a small amount of experience needed. The main cause of poor engineering is that we frequently stress the latter and neglect the former, in other words we follow in the way it was done before rather than using the common sense method and study the problem extensively before we begin. Right here I wish to state that an error in Engineering is a very expensive thing as the loss is accumulative and lasts for the life of the job. The engineer must therefore study the present and future requirements, calculate interest charges as well as transmission losses and aim at obtaining maximum efficiency not only at the start but throughout the life of the system.

Bearing in mind therefore the above points the procedure would be as follows:—

Firstly—Obtain an accurate plan of the municipality drawn to scale.

Secondly—Obtain as accurately as possible the habits and characteristics of the inhabitants.

Thirdly—Locate the factory districts and also the feasible location for future factory sites or other power users.

Fourthly—Do the same for the residential districts.

Fifthly—Study the map and plan the system.

So far the method is the same for all municipalities independent of size. The size does not necessarily mean area or population, but is a combination of both tempered with the engineer's optimism and his faith in the future of both the municipality and the utilization of the utility. Assuming the

"Size" has been determined, the question next arises, what voltage shall be used? Fortunately standards have been set which simplify the engineer's work. He knows that lighting circuits will have to be 115/230 volts. He also knows that in 25 cycle districts 550 volts is the standard power voltage; further that distribution transformers are built to work on about 2300 volts, so his primary system will have to be suitable for the transformers, which are available. His fundamental training has taught him that power can be transmitted with less loss if he uses high voltage, hence the primary will be 2300 volts Y connected or as we say 4000 volts. Where the engineering comes in is how much primary he shall use, what length of secondary can be run and take care of future load without extending the primary, and can he stop with a 4000 volt primary or must he transmit at a higher voltage to substations at various points? This can only be answered by a calculation of the losses, and here again we must be governed by the future requirements as well as the present, and let me repeat that losses include annual charges on money spent as well as copper losses. This brings us to what is known as the Economical Cross Section, a condition that exists when the copper losses equal the annual charges. This is approximately 1 h.p. per M. cir. mils. per 1000 volts for weather proof copper three phase distribution and can be applied very rapidly to existing circuits as well as used in designing new ones. For example, take a No. 6 copper conductor which has a cross section of 26,250 cir. mils. or 26.25 M. cir. mils. If used as a 110 volt single phase secondary the economical load would be ½x1x26.25x110÷1000=1.44 h.p., at 220 volts, 2.88 h.p. If used on a primary line at 2200 volts three phase the economical load would be 57.7 h.p. or at 4000 volts 105 h.p. A No. 4 line would have a cross section of 41.74 M. cir. mils. and carry a load of 2.3 h.p. at 110 volts single phase, 4.6 h.p. at 220 volts single phase, 92 h.p. at 2200 volts 3 phase and 167 h.p. at 4000 volts three phase. This is an excellent guide in roughly checking all circuits, and is approximately correct with weather proof copper costing 24 cents per lb. and power costing $41.00 per h.p. per year, annual charges being taken at 12 per cent. Where power is $30.00 per h.p. per year the load which could be carried would be 1.17 h.p. in place of 1 h.p. per M. cir. mils. per 1000 volts.

The economic loading is independent of the length of conductor and the designer must not forget that regulation is another matter. The most suitable method of obtaining the size of copper is to first obtain the Economical Cross Section and then check the drop and regulation. In so far as all systems are expected to last for the life of the debentures it is always advisable to plan with the view of obtaining increased load, and although the present or near future requirements may not warrant high voltage lines the plan should first be made to take care of the worst conditions. The system should then be constructed in such a manner that it can readily be changed over, but be economical with present and near future loading. By this is meant that it will be found impractical to transmit

more than a certain load for a certain distance with a given voltage, and if either the load or the distance or both increase the voltage must be increased and the original plans should provide for this.

Let us look at what is meant by an economical system. Undoubtedly one with low capital investment, low losses and small maintenance. The engineer must balance his design in regard to the first and last points as well as watch the second. However as the utility becomes more and more popular, continuity of service becomes more important and low investment is hardly possible, and present practice is tending towards the highest grade construction possible in towns and cities. In rural districts and small villages where the cost of high grade construction would prohibit the service, cheaper construction must be used. The Handbook for construction of Electrical Distribution Systems issued in June, 1924, contains some valuable information re. standard construction. Besides the points mentioned above no system could be called economical which in itself is responsible for an increase in the cost of power (power factor penalty) or one that is partly loaded with wattless current. It is therefore necessary to use or allow to be used, only apparatus requiring a minimum excitation. In this connection the contracts with consumers on the Hydro Systems, and I expect on most other systems, give the System management the right to refuse service to any apparatus which does not meet with their approval. Our superintendents are quick enough to refuse service to a squirrel cage motor under certain conditions but allow a customer to purchase apparatus with high excitation, and then penalize him for low power factor a condition which does not seem quite fair. At the same time there are still a number of managers who either have not studied the ills of their system or have failed to properly diagnose the trouble and work towards a proper remedy. In all cases an ounce of prevention is worth a pound of cure, and although the engineer plans his work well and hands over a system which is an example of efficiency, lack of knowledge, carelessness or stubbornness on the part of the manager or superintendent will soon necessitate either a consultation with the engineer or the employment agency. Unfortunately the damage has usually been done before the engineer is called in or I should say can get in. Our experience has been that any advice or suggestion given is usually ignored until the ship begins to sink then when it is necessary to get more money the engineer has his turn. In all fairness to the managers and superintendents I want to say that they are usually quite busy with other things, Hydro shops, customers' accounts, salesmen and radio fans to say nothing of the reports and information asked for by the district engineers. The point I wish to make is that the distribution system is most important, as it is the basis of all the business, is, in fact the medium through which everything else is made possible. For this reason it is of primary importance to have it in perfect health and every addition, change or extension must be as good or better than the original installation. Carrying our analogy further it is necessary to prune and trim in order that the tree will

grow properly, cutting out the suckers and grafting on some new branches to keep the system in good condition. One would not consider putting in a second parasite to kill the first as is often suggested by the addition of so-called corrective apparatus. A much better plan is not to allow the first parasite to get started.

Since the installation of graphic, kw. and reactive kv-a. meters in the station and the recording volt meter and split core current transformer and ammeter, all of us have available the stethescope for analyzing the trouble and prescribing the remedy. A study of the load on each distribution transformer by volt meter and ammeter will show whether the secondary conductor is suitable or the transformer properly loaded. The same instruments give the required data on primary lines and the kw. and reactive kv-a. charts can be used to study the power factor. The method followed by the writer in a study of the power factor conditions is simple and is as follows:—

A month's charts of the municipality are obtained, also a record of the number and size of all transformers and motors on the system. The Sunday chart will show the reactive kv-a. of the transformers. This is checked by reading the week day charts after the motors are shut down; i.e., from midnight to 7.00 a.m. or making allowance for any 24 hour motors. The total reactive kv-a. less the transformer reactive kv-a. is equal to the motor reactive kv-a. Knowing the kv-a. capacity of the transformers the ratio of reactive kv-a. to kv-a. is the exciting current in per cent. In case the station transformers are measured on the chart they can be eliminated by obtaining the data from the test records. From experience we are able to pick out the transformers having excessive exciting current and an estimate can be made to see what the total power factor would be if all poor transformers were replaced with the low exciting current type. It is noticed that in most towns and cities in the Niagara District where the power factor is low, transformers and motors create about an equal reactive kv-a. New transformers throughout would have about one-quarter the reactive kv-a. of the old ones, which would bring the total reactive kv-a. to five-eighths of the existing reactive kv-a. This is usually sufficient to raise the total power factor above 90 per cent. even in towns where the power factor is considered low, say 80 per cent. It is then easy to calculate if it will pay to scrap all the old transformers and buy new ones. In some cases only the worst offenders need to be got rid of depending on the amount of trouble we have in motors as well as transformers. My critics are going to ask "Why do I pick on the transformers only?" I would, of course answer that I don't as shown by an article on motors which appeared in the Bulletin about a year ago, but in any corrective work one starts at the most outstanding trouble and where his efforts are most productive. There is a second reason namely, that the transformers are owned by the municipality and the correction is in the hands of the operators of the system. It is also well to clean house oneself before pointing out how dirty the neighbor's place is. About here I wish to thank the manufacturers for the whole

hearted way in which they have dug into this matter and to congratulate them on what they have accomplished. I would also like to express my regard to those managers and superintendents who are studying the conditions in their respective systems and insisting on receiving apparatus which improves their conditions. To those other managers let me say that it is up to them to thoroughly know their system and unless they have studied it, know its weaknesses and are seriously endeavouring to correct its faults they are neglecting the foundation of their business.

In connection with the extent we should ask the designers to go on keeping down the exciting current, I would say that there is a limit beyond which we get an unbalanced design (please refer to paper by Mr. Baker read at Orillia) which although excellent from one viewpoint is not so good from another. Low core loss and excessive copper losses result in poor efficiency at overload points and also affect the regulation. The engineer, manager or superintendent can arrive at the economical point by a study of his own conditions or he can use a hypothetical case and examine what occurs. It is obvious that in cities or towns with heavy loads and long secondaries, transformer regulation is more important than on rural lines where there is usually a transformer for each service. In the latter case we can go to the extreme in securing low excitation due to the preponderance of transformers. A fair example of the other extreme would be the City of Toronto and there I believe they consider one watt of core loss as bad as four or five watts of copper loss. In calculating the effect of transformer regulation on total regulation the economical cross section gives a regulation in secondary conductor of about 4½ to 5 per cent. The difference in regulation of a transformer designed for low excitation and average excitation is about 1/3 of 1 per cent. Hence the effect on the total regulation is very small and can usually be neglected. The other argument we have is overload capacity and hot spots. The experience of those who are using transformers is a better guide than anything that can be said and by asking yourself the question "How many transformers have been lost from this cause?" the question is answered.

Before closing I wish to comment on the practice of using two transformers on one pole, each attached to the one primary and the secondaries connected at 110 volts in series giving a three wire system. This is only excusable in cases of concentrated loading and where a certain sized transformer has been standardized upon for obvious reasons. In general distribution it has only one other point in its favor; namely, that each leg can be fused on the primary side. The disadvantages are many, some of them being, single phase primary distribution, poor secondary regulation, heavy pole loading and the fact that fusing for each leg is not essential as our good friends the designers have taken care of that pretty well. It is to be noted that the cooling area remains the same and will dissipate the same amount of heat, even if it does come from a smaller section.

The distribution system in addition to lines and transformers is affected by

the customers' load, and care should be taken to guard the system and the customer's pocket-book by preventing the use of equipment unsuited to the work to be done. In 25 cycle districts low power factor is not a necessary evil. In 60 cycle districts, although transformers are less of a bugbear the poor motors more than make up the difference. Inherently the power factor is low on 60 cycle motors especially if underloaded. The manager therefore should assist the system by acting as a consultant to all power users. His advice would be to see that motors are purchased for as high a speed as is possible, that they be loaded, and it is within reason to expect that in some installations synchronous motors could be used to advantage. He should not wait until the customer has purchased his equipment and then penalize him as that is unfair and it must be remembered that the manager is hired to supply service to customers and not merely take their money. On systems where motor loads predominate and it is impossible to maintain good operating conditions even where good apparatus is used a synchronous motor could be installed by the municipality.

This paper was asked for with the expectation of opening a discussion and I will have failed if all the delegates do not rise at once. The paper is not complete but the discussion should round it out.

Discussion

Mr. O. H. Scott, Belleville: Mr. President: I was asked to lead the discussion on this paper. I think Mr. Caster has very well fortified himself in most of the statements he has made. He is, however, looking at the paper from a strictly engineering viewpoint; and possibly if he were in the local manager's office and figuring, as he said, on sales and loading up his system and a few other things, he might not have the opportunity of sitting down and figuring out these things absolutely on an engineering basis before he had to get busy on some other line.

It is quite all right to have a nice map, and to lay out a plan of how you are going to build your lines, if you are building a new system. But if you have an old system or possibly two systems that you are taking over, and you are increasing your range load, your power load and your commercial load all at the same time, it is a difficult matter for the manager and engineer, in the smaller municipalities at least, to figure the economic cross-section. He may find he is going to run into too much money in establishing a rule of thumb, saying here is a certain sized transformer and run a certain size of line from it.

In regard to transformers, the same thing happens. You estimate that possibly a 25 kv-a. transformer is a good size to put on your lines, and your load is going to grow to that at some time in that section; and the first thing you know you are underloaded or overloaded. The blowing of fuses is no indication of what the transformer will carry.

We have found on occasions this winter, transformers overloaded at least a hundred percent, but have had practically no trouble through the burning out of transformers from the heavy overloading. It is really surprising the overloads they will carry.

Mr. Caster makes the suggestion that the manager should see that the customer adopts the right equipment. In our district we are 60-cycle, and the transformer perhaps is not such a bugbear as it is in 25-cycle. But when it comes to motors, it is a question for the manager to go into and advise the power user as to what he should buy.

Mr. H. F. Shearer, Welland: There is one question I would like to ask Mr. Caster, and that is in banking the transformers, how does he prevent the circulating current? I have had some experience in attempting to bank two transformers on a three-wire system and found some 75 percent of the current was made up of circulating current.

Mr. C. E. Schwenger, Toronto: There are one or two points I would like to ask Mr. Caster. The first is that in which the annual charges are figured at twelve percent on the invested capital. There is nothing to show how the annual losses are figured or the cost of them. The statement is made that when the copper losses equal the annual charges you have the most economical cross-section. I would like to know how that was figured to get the result which Mr. Caster mentions.

Now, another thing, the most economical cross-section is the one that exists when you have the copper losses equal to the annual carrying charges; that is true only where the various sizes of the conductor bear the same cost per M.cir.mils. I made a rough check and found that the cost per M.cir.mils of No. 6 and going down the scale is as follows:

No. 6, $4.53; No. 4, $3.67;
No. 2, $3.37; No. 0, $3.28.

But smaller sizes are apparently under discussion just now, and there is a fair discrepancy there which alters the determination of the economical cross-section. I would recommend in figuring out the economical cross-section, that, instead of taking the rule, one should actually figure it out for the local conditions.

Another point mentioned was the apparent improvement of power losses in the City of Toronto as affecting the transformers. What we are after in Toronto is low exciting current and with that low core loss.

Another point Mr. Caster has brought out was how many transformers have been lost from overloading and hot spots. In Toronto we have kept accurate figures for the last seven or eight years, and find that the losses due to burnouts of all kinds is less than one half of one percent. per annum, which is very small.

Further on he mentions the disadvantages of using two transformers in series on a three-wire system, that you have to have a single phase primary distribution. I do not see the difference, as affecting the distribution system, whether you use two 25 kv-a. transformers in series or one 50 kv-a. transformer. He mentions poor secondary regulation as being caused by two transformers in series. The

regulation of the transformer is just as good at 110 volts as it is at 220 volts. Another point which is considered as a disadvantage is apparently the heavy pole loading. I have checked up the weights of transformers, and have found that there is no disadvantage from the weight standpoint.

Now one of the advantages of connecting transformers in series is that one side of a three-wire system can go out of use, due to short circuit through overload, and the remainder still operate. This is very important where a three-wire system is in use, because it enables some of the consumers to have their apparatus in commission. For street lighting it is of importance, because every alternate light would still work, and you are not utterly in the dark.

The next point that might be stressed as affecting the electrical engineer is the point of banking transformers, which does not appear to be common practice, especially on house lighting. Transformers should be banked. Tests which we have carried out show that we have increased the transformer capacity by approximately ten percent by having them banked.

Another point is the economical transformer spacing, Mr. Caster recommends that we do not place them closely together. This was taken up in a previous paper, where the economical spacing was worked out.

Mr. C. W. Baker, Packard Electric Company: Where you have a transformer of high exciting current, five to seven percent, Mr. Caster would throw it out very quickly. But supposing you have a system which already has a synchronous condenser and you are keeping your power factor well up, would not the limit of the exciting current be much higher before it would be economical to throw that transformer out of the system?

Mr. Caster: Mr. Baker wanted to know if one had a synchronous condenser whether that would not help out the power factor conditions? Undoubtedly it would. I was trying to point out that a synchronous motor was not a joy forever but a source of expense, and that it is not the very best thing to have around if it can be avoided. However, if you have one and it is capable of keeping up your power factor, there would be no sense whatever in throwing out a lot of good transformers.

Mr. Schwenger said banking transformers, saves ten percent of the transformer capacity. I do not doubt that, but if he banks those transformers he has to tie them all in on the same primary, and hence has single phase primary transmission. Also he mentioned that I suggested placing the transformers closely. I want him to grasp the fact that I tried to make Toronto as nice an exception as I could, that Toronto is different, their load is concentrated and warrants putting two transformers on the same pole, frequently; but I did not say or suggest that he should put a 50 kv-a. up on that same pole. I suggested that the secondary regulation would be better if you put a 25 on one pole and then went down two or three poles and put another 25 up there.

Mr. Schwenger: We have them closer together than you have just spoken of. What I meant was that as between squares we had them on every

pole, in fact, we have two on one pole in some places on some busy streets.

Mr. Caster: If your load warrants a 50kw. transformer, I think it would be much better to put up the two 25 kv-a. transformers, one near one end of the block and the other near the other end, rather than to have to put two of them on the one pole. But your conditions are exceptional when you have to pile two 25 transformers on every pole; that rather knocks out any argument in regard to the regulation of secondary. But my point is where you can put one on one end of the block and another on the other end of the block, it is better than having to put two of them on one pole, not banking them but distributing them. In a municipality such as Toronto, with concentrated loads such as Mr. Schwenger has, I would do the same as Toronto has done, and buy two 25's rather than 50's, because, I believe, they are more easily handled.

Mr. Schwenger recommends his system due to the fact that if one transformer goes out, he still has fifty percent. of the load being carried. If you put the one transformer at one end of the block, and the other transformer at the other end and the fuse blew, you will not have every other customer out, but you will have them all out in a bunch. The other half would still have light.

Mr. Schwenger wants me to give away a secret, and to tell you how the copper losses are figured. I am not going to give away any family secrets on how we calculate the Economical Cross-section. I have already let the cat out of the bag and told you Mr. Stocking gave me the formula, and as far as I can see the formula still holds.

The Economical Cross-section is undoubtedly as stated, of great service and is the condition which exists when copper losses equal the annual charges. That is approximately, as I said, one horsepower per M. cir. mils. per thousand volts, which is equal to the square root of p. multiplied by c. divided by s., multiplied by a constant, where p. equals the percent. of the annual charges, and if you are going to get really fussy about this formula you might trip me up about what the annual charges are. I told you that we figured the annual charges at 12 percent; but if you prove that the annual charges are different from that, the result will be different. C, is the cost per pound of copper, I figured it at 24 cents per pound. S, equals the cost of power per horsepower year; that will be forty, thirty or sixty dollars, or whatever it is. And that constant, for your enlightment, is 1424. Do not ask me how I got it. I will give you the same information as was handed to me. "Figure it out." We have figured it out and find it is about right.

Now, the whole theme of this paper was an endeavour to impress upon you the absolute necessity of figuring it out. It is all right to say, we are mighty busy, we are the manager, and in our small system we cannot take the time. If you cannot get the time, take a kid out of the High School and teach him the formula. We have to work out your annual operating report. You are more interested in it than we are. All we want to do is to get it down to go into the annual report. We have not the time to give

your separate systems the study that they need, and it is entirely up to you to get down to details. As managers you are falling down if you do not do so.

Mr. Scott said that down in their district the consumers do not ask the manager what they should buy. That is all right. The customers go ahead and instal their equipment, and then come to the manager and asks for power. It is pretty difficult. The meter may not be leaking, but there are other things which bother you. It is up to you. If you know that Jim Smith is going to put in a 3-hp. motor down in the creamery, you should look after him and see that he gets one at 1500 r.p.m. at least. Did you know that a slow speed motor costs more money than a high-speed?

I do not yet understand why a customer would want to put in a low-speed motor rather than a high-speed. It is generally because they think it will be a better motor. It is not a better motor. As a rule, a high-speed motor is a better motor and costs less. The only reason is that the customer does not know any better; but the agent's commission will be better. I may be wrong in this, and am open to correction, but any way a slow-speed motor costs more money and should not be allowed, if it can be avoided.

Mr. Shearer asks about circulating current in the banking of transformers. If they were ten years old, I do not think the circulating current would be more than ten percent.; but I have recommended against banking, especially on the smaller systems as the small gain in transformer capacity is lost on account of circulating current, single phase primary transmission, etc.

The Secretary of the Association of Municipal Electrical Utilities has received the following letter from Mrs. Strathearn Hay (née Marion Beck) and wishes to take this opportunity of placing it before the members of the Associations to whom it is addressed.

The Pines, Naples, Fl., Feb. 16th., 1925.

Association of Municipal Electric Utilities,

and

Ontario Municipal Electrical Association,

Dear Sirs:—

I would like to take this opportunity of thanking you on behalf of my husband and myself for the very beautiful silver which you were kind enough to send us, and I can assure you it was greatly appreciated.

I would ask you to please convey my thanks to the members of the Associations..

Yours faithfully,

Marion Hay.

Automatic Stations And Supervisory Control

By L. B. Chubbuck, Engineer, Canadian Westinghouse Company, Limited, Hamilton, Ontario

(Paper read before Association of Municipal Electrical Utilities at Toronto, January 28, 1925.)

ONE of the most interesting electrical developments of the last few years is the complete automatic operation of generating and substations, and the distant control of such stations by Supervisory Control. The first small automatic railway substations were rapidly followed by others and at the present time there is in operation in the United States and Canada a total of over 700 fully automatic stations. The total capacity of this equipment is over 600,000 kw., with units ranging in size up to 10,000 kv-a.

While the great advantage of automatic stations is the reduction in labor expense and possible labor trouble, there are numerous other advantages. In the case of railway substations these may be distributed over the system, reducing the feeder copper, mitigating electrolysis, and improving the average trolley voltage. Also, in all automatic stations, the machines are operating only when needed, and due to the very complete system of protective devices, can be temporarily overloaded to a much greater extent than would be safe with manual operation. Early automatic stations were purchased almost entirely from an economic standpoint, but such stations have proven so much more satisfactory than manual stations, that continuity of service is now one of the chief arguments for the automatic station.

The small hydro-electric generating station is an important new field opened by automatic control equipment. With this equipment thousands of small waterpowers that would otherwise not be developed, may now be profitably developed and operated. Many streams can be developed cheaper by using several smaller plants than by using one high head installation. There are also many small water powers in the vicinity of present stations, mills, etc., that can be developed profitably, and if desired, controlled from the present station.

Automatic Railway Substation.

The switching equipment for an automatic railway substation comprises the various contactors, relays, etc., required for starting or shutting down the station, and numerous protective devices. The contactors operate in sequence, connected so that no operation can be started until the preceding one is completed. A brief description of this equipment will be given for the ordinary self-starting synchronous converter station.

The station is usually started either by remote supervisory control, by push button, or by a low-voltage D.C. relay connected between the trolley and

ground at the station. When started by the L.V. relay in case trolley voltage drops to 75 per cent. of normal, these relay contacts close a circuit through a time delay relay (to prevent starting due to momentary low voltage) which after a predetermined interval operates the master relay, which locks itself in. This energizes a relay which starts the brush liftery motor, which in turn operates until the brushes are fully lifted being stopped by a limit switch. An interlock then energizes a relay which closes the main oil circuit breaker and the starting contactor. The field switch is normally closed and as the rotary comes up to speed the D.C. polarity may be correct or incorrect. In the latter case a D.C. polarized motor relay operates a field relay which reverses the field contactor. As the rotary D.C. voltage drops to zero the field relay is de-energized allowing the field contactor to return to normal position

Fig. 1—Automatic Railway Substation—Toronto Hydro-Electric System, contains 1-1000 kw. 600 volt Rotary Converter, Stepdown Transformers, etc.

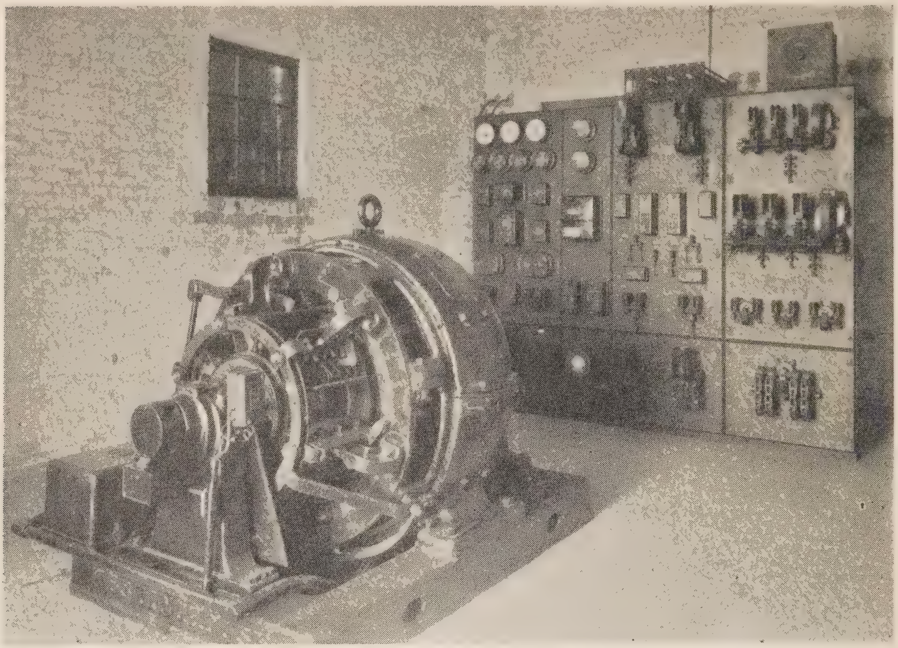


Fig. 2—Interior of Automatic Rwy. Substation, Montreal & South Counties Rwy. 500 kw. 600 volt Rotary Converter and Control Equipment.

and the rotary builds up with correct polarity. The D.C. polarized motor relay now operates relays which open the starting contactor and close the running contactor. The brush-lifting device is then operated to drop the brushes. The rotary is now running light ready to connect to the trolley. The D.C. line contactor is then closed making connection to the trolley through three steps of resistance. The resistance shunting contactors are now closed in turn by D.C. overload relays if normal load is not exceeded.

When load demand from the station has decreased below a predetermined amount a D.C. underload relay operates a delay relay and if the load remains low for a set period of 3 to 30 minutes the station master relay is de-energized opening all contactors, etc., and shutting down the station.

The protective features of a railway substation comprise (a) A.C. overload relays set high, (b) D.C. overload relays to cut in grid resistance and limit D.C. current to 1½ times normal, (c) overload thermal relays permit operating machine to the maximum under sustained or repeated overloads, (d) Bearing thermostats, (e) Thermostats for mounting on the grids, (f) Phase unbalancing, (g) Reverse Phase and Single Phase, (h) A.C. low voltage, (i) No Field, (j) Overspeed, (k) D.C. Reverse Current, (l) No start Relay (in case rotary fails to start).

Relays (a), (d), (l), besides shutting down the station, operate a lock-out relay which must be reset by hand.

The other relays operate only until the respective trouble is corrected.

The protection of the D.C. feeders leaving a substation is important. One method consists in the use of feeder current limiting grid resistors which are automatically inserted in steps by contactors. This method is satisfactory in some cases, and may permit the use of smaller machines. However, in city service it is advisable to hold up voltage as high as possible on feeders and not to open a feeder except in case of actual short circuit. A short-circuit detector and service restoring equipment has been developed which fully meets the required conditions. In this equipment a series transformer connected across a relay is inserted in each D.C. feeder. In the case of short circuit a momentary current is induced in the secondary of the series transformer, which operates the relay and opens the feeder contactor. Under the condition of ordinary overloads, the relay is of course unaffected. Across the feeder contactor is connected a high bridging resistance and the drop across this resistance operates a sensitive relay which in turn automatically recloses the feeder contactor after the short circuit has been cleared.

Automatic Hydro-Electric Generating Stations.

The control equipment for these stations as in the case of railway substations consists chiefly of a series of contactors, etc., with necessary protective devices. The Hydro generating stations, however, are usually started by (a) Water head, (b) Reduced system frequency, (c) Remote pilot wire or supervisory control, (d) Push button in the station, (e) Time switch, (f) Manipulation of the A.C. line.

In starting by any of the above methods:

(1) A master relay is operated.

(2) This starts the oil pump motor to ensure ample oil pressure for operation of governor, gates, brakes, etc.

(3) The governor solenoid is energized, causing partial opening of the gates and acceleration of the unit. During this starting period the generator field is short circuited and as the exciter rheostat is shunted the exciter builds up very quickly.

(4) A small magneto generator is geared to the generator shaft and connected to sensitive relays to act as an accurate speed device. When the generator has reached 95 per cent. synchronous speed, these relays operate other relays which, in turn, close the oil circuit breaker tying the unexcited machine to the line. The closing current for the oil circuit breaker is obtained from the exciter.

(5) The generator field is connected to the exciter and the short circuit removed from the exciter field rheostat putting the generator voltage under control of the voltage regulator. The generator now pulls into step with the system and takes its share of the load as the governor further opens the gates.

The above method of starting is smooth and very satisfactory with generators having cage winding, and usually with generators having solid field poles, unless the generator is too large a portion of the system generator capacity. Where a different method of starting is necessary, current reactors, low voltage starting or synchronizing

may be used. The current reactors are connected in the generator circuit when starting only, and then shorted by a breaker. A low-voltage starting tap may be used in the step-up transformers if there are such transformers. To synchronize an incoming generator with the bus or line a thoroughly reliable automatic synchronizer has been developed. This includes a speed matcher comprising two small synchronous motors, one connected to the generator and one to the bus. These motors operate a mechanical differential connected to contacts which control the speed adjusting motor on the water wheel governor. This brings the generator to exactly synchronous speed and at the first favorable opportunity other contacts in the automatic synchronizer close the oil switch.

A generator unit may be shut down by light load, or by several methods corresponding to those for starting up, also by the protective features. Normally the governor solenoid is de-energized which causes the governor to gradually close the gates to the no-load position. At this point a contact is closed which, through relays, trips the oil circuit breaker. The field switch is then opened and the brakes applied. In emergency the oil circuit breaker could be tripped at once by button or supervisory, the overspeed relay then operating to complete the shut down.

When there is more than one generator unit per station the units are arranged, when under automatic control, to start up or shut down in a predetermined sequence.

Protective Features.

The protective features for a hydro-electric station should be very complete and usually consist of the following:—

(a) A.C. overload relays connected differentially across the generator and a second set across the step up transformer bank (if there is one). This protection is generally omitted on small machines below say 500 kw.

(b) Oil pressure relay to operate on low oil pressure.

(c) A.C. overload thermal relays.

(d) Bearing thermostats.

(e) Field failure relay connected in generator field and with time limit feature.

(f) Overspeed relay operated from magneto geared to generator shaft.

(g) A.C. overvoltage relay to operate at about 25 per cent. over voltage.

(h) D.C. overvoltage relay to operate at about 10 to 15 per cent. excess exciter voltage.

Relays (a), (d), (e), and (g) besides shutting down the station, operate a lockout relay which must be reset by hand.

Relays (b), (c), and (f) shut down the station only as long as the respective trouble exists.

Where the station equipment includes a battery, service transformers, or delivers power through several lines, the usual relay protective apparatus is provided.

Supervisory Control.

Owing to the widespread installation of automatic stations a demand arose for information at the main station of what was happening in distant, or unattended stations. Also a dispatcher may at times wish to control the operation of such stations from his

central control room. There are also many cases of plain electrically operated distribution stations where operators could readily be dispensed with, if the central dispatcher had distant indication, and control of the various breakers, etc. To meet this demand a number of systems of "Supervisory Control" have been developed employing standard automatic telephone or telegraph apparatus. This ensures the use of reliable well-tried equipment, and small operating currents permitting the use of existing telephone circuits if desired. Supervisory Control has now been developed to give remote control and indication of practically every operation or instrument ordinarily used in generating or substations. The usual operations, etc., comprise, closing, tripping, and indication of oil circuit breakers, various contactors, distribution feeder breakers, starting or stopping of machines, voltage or speed control of machines, etc. Remote indication can be obtained of the height of water in forebay, waterwheel gate opening, remote metering for current, voltage, power factor, kw., kv-a., etc.

The Audible Type supervisory control is the simplest and cheapest form and is used for smaller stations where a few operations and slow speed are satisfactory. A number of substations may be controlled over two wires that can also be used for telephone service. The dispatching station equipment consists of a standard telephone or loud speaking horn, a telephone dial and a few line keys. The substation equipment consists of a few relays step-by-step selectors, and microphone with buzzers or bells to signal back to the

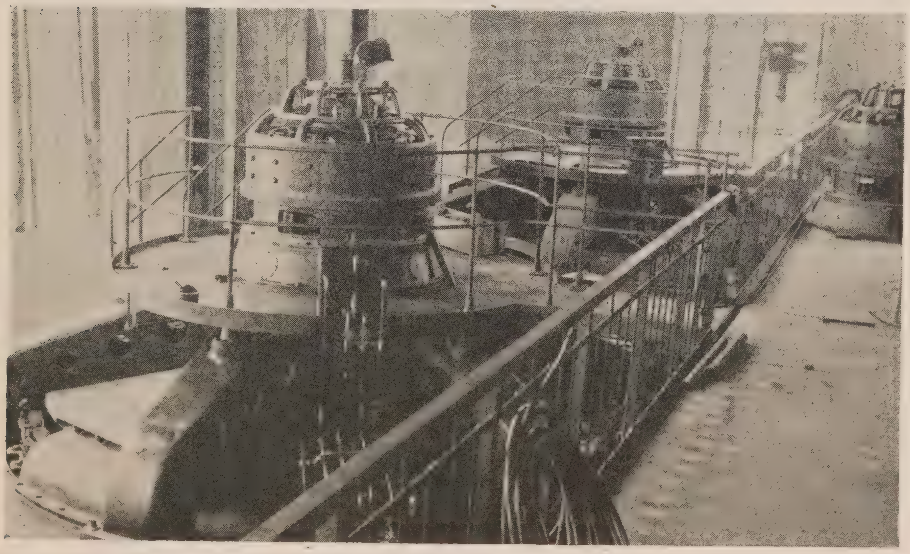


Fig. 3—Generators Nos. 2 and 3, Dam No. 8 Development, Hydro-Electric Power Commission of Ontario.

Fig. 4—Power House, Dam No. 8 Development, Hydro-Electric Power Commission of Ontario.

dispatcher. A small battery is required in each station. The selector is similar to a three- or four-deck rheostat dial, the arm stepping one point ahead at each interruption of current.

The general scheme of operation is as follows: In case the dispatcher wishes information from say Station No. 3 on Line No. 2 he would first throw line switch No. 2 and dial No. 3 point. This interrupts the line current three times and the selectors of *all* stations on this line will step ahead to the third point. In only station No. 3 however, is this point on the selector connected through for operation and the other selectors are locked out of service. A single stroke bell striking three times in front of a microphone notifies the dispatcher that he is actually connected to No. 3 Station. Should the dispatcher wish to close a circuit breaker, he would now dial say No. 2, which would step No. 3 Station selector ahead two more points and close a local circuit to close the breaker. The breaker position will be signalled back by a high toned buzzer, a low toned buzzer being used for trip position. To obtain the head of water the dispatcher would now dial say No. 4 to connect him to the water level signalling apparatus. This apparatus may be similar to a rheostat dial with usually 10 points. If the arm is on the fifth point a buzzer would signal five times indicating 50 per cent. of full head.

It is evident that a dispatcher, after becoming experienced in the use of this equipment, can perform many remote operations and obtain much important information from distant stations.

The *Code (Visual) Type* of supervisory control gives the dispatcher at all times a visual record on his desk of the position of all breakers, gate openings, etc., in remote stations, operating keys and red and green, etc.,

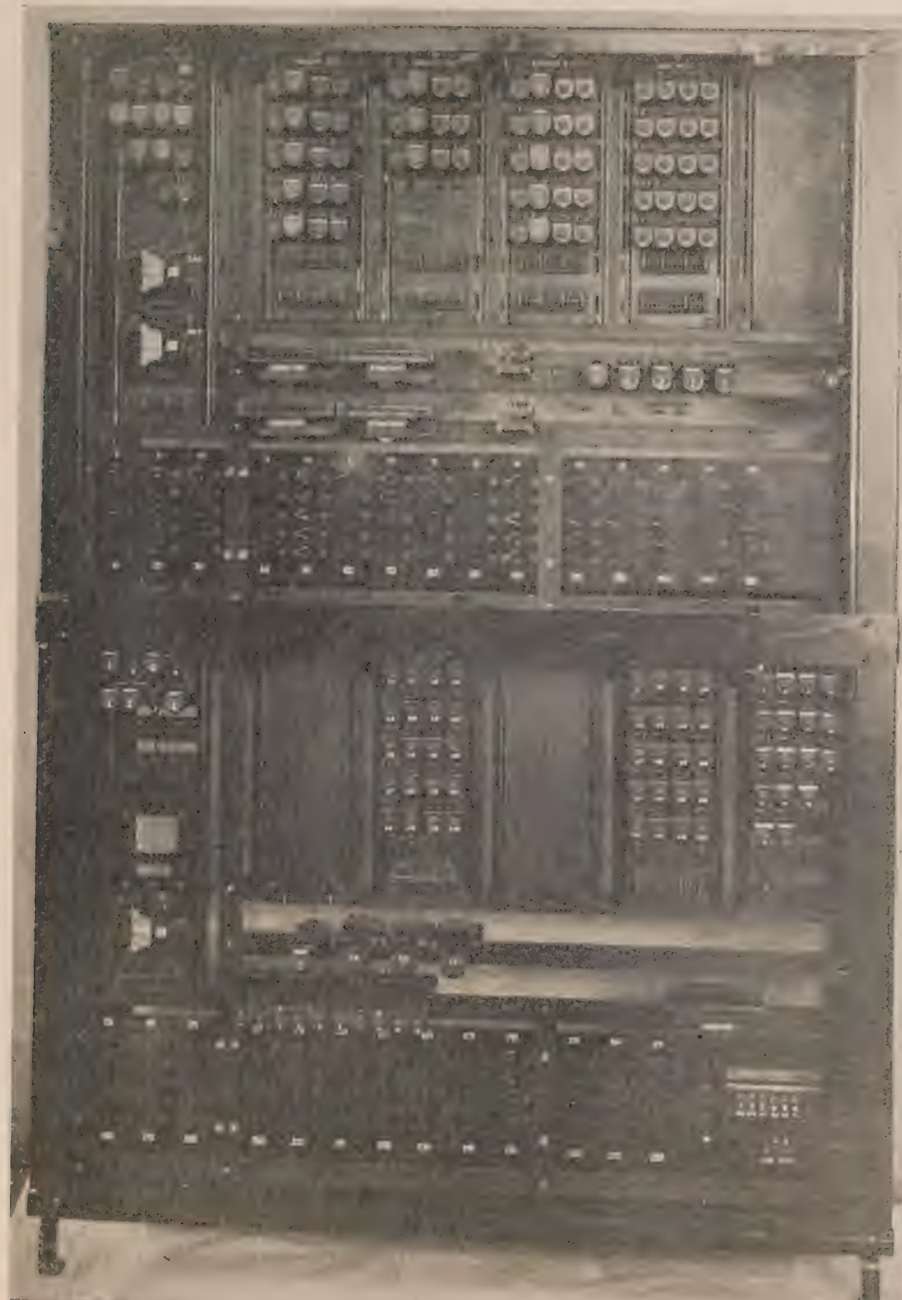


Fig. 5—Code (Visual) Type Relay Cabinet at Dam No. 8 Development, Hydro-Electric Power Commission of Ontario.

lamps being used as in the case of an ordinary electrically operated switchboard. In addition to the above apparatus, various relays are furnished in cabinets at both the dispatcher's station and the remote stations. A 48 volt storage battery is furnished for each station. Three wires are required from the dispatcher's station to each station, viz., one for the operating pulses, one for receiving pulses, and one common return.

In this system for any operation the dispatcher simply closes the corresponding key, and at the same time a safety key. The corresponding code of impulses is then automatically sent through and the operation performed at the remote station by relays and rotary selector switches. These switches have twenty-five stepping points, and different codes depend on the points on which pauses are made. For instance one code may have pauses on the tenth, twelfth, and twenty-fifth point, another code on the fifth, thirteenth, and twenty-fifth point. The selector switches at each end of the line step in synchronism, and during the pauses, at the receiving end, slow acting relays drop out and complete a circuit through interposing relays to breakers, etc. In case of a breaker automatically tripping at the substation, its pilot switch starts a code back changing the corresponding indicating lamps on the dispatcher's desk. Other changes such as water level, gate opening, etc., are indicated in the same manner.

After any operation has been started by the dispatcher, the sending switches keep sending through the code until the return code from a pilot switch, etc., has been received back to operate the lamp relay, which in turn stops the original sender. A small monitor lamp opposite the sending key remains lighted as long as an operation is incompleted. It is thus evident that any trouble in the line or apparatus is at once made evident to the operator. There is also furnished on the desk a checking key, the closing of which causes all the substation apparatus to send back their code, in turn, as a check on all indicating lamps on the desk.

The *Synchronous (Visual) Type* supervisory control was developed to provide the maximum speed, particularly where a very large amount of apparatus is to be controlled. In its highest speed form, it is more subject to line interference than the code (Visual) type. A full check can be obtained by adding checking relays, which, however, slow down the speed somewhat. The synchronous system requires four wires between stations, three if a common ground return is used. One wire is used as a "drive" wire to operate in synchronism a selective set of relays at the dispatcher's station and a corresponding set at the substation. A second wire is used for a common return (4 wire system). The third and fourth wires act as a metallic bus between stations and when an operation is to be performed each end of this bus is connected in sequence to relay contacts No. 1, No. 2, No. 3, No. 4 . . . . to say No. 10, then repeat to No. 1, No. 2, ...

Assuming the dispatcher wishes to close breaker No. 5, he will operate key No. 5, and also a start key. Assume key No. 5 is connected to relay

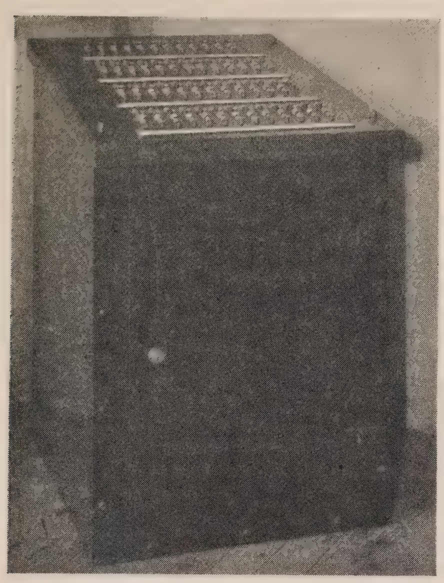


Fig. 6—Dispatcher's Desk (Synchronous Type) Carlow St. Station, Toronto Hydro-Electric System. To Control 50 Breakers at Danforth Av. Station.

contacts No. 5 and at the substation end relay contact No. 5 is connected to breaker No. 5. On pressing the start key the selecting relays in each station move in synchronism from point to point and stop on relay contacts No. 5. Operating current will then flow through the bus between stations to close the breaker. The breaker pilot switch transmits its signal back to No. 5 lamps on dispatcher's desk. This also releases the selector relays which complete their cycle and stop. By pressing a stop key the selector relays may be held as long as desired on any point for reading a signal, remote metering, etc.

Remote Metering.

What is proving a very important adjunct of supervisory control is known as "remote metering". It is evident that with a metallic bus between stations, as in the Synchronous Type supervisory system, the dispatcher may get into connection with any substation meters, current, or voltage transformers, etc. desired. Several remote metering systems have been developed that will transmit over such a bus any of the usual station meter indications.

In the "D.C. Impulse" method, there is used at the substation an instrument, such as an integrating watthour meter, with speed proportional to watts, etc. On the shaft of this instrument is added brushes and a commutator to make and break contact four times per revolution. Connections are so made between this commutator and a relay that D.C. impulses of alternating polarity are sent to the dispatcher's station. At the latter station an instrument is used with an escapement wheel actuated by these impulses and thus having a speed exactly proportional to the substation meter. By a ball movement the speed of the escapement wheel can be compared with a small synchronous motor giving a pointer indication or graphic record. If permanent wiring is available between the stations for this instrument only, integrating dials can be added to the escapement wheel to register total watt-hours, etc.

The "Current Balance" method of remote metering employs a contact-making Kelvin Balance meter at the substation, the balance being opposed by a D'Arsonval movement, instead of the usual spring. A sensitive motor-operated rheostat in the meter is op-

erated by the balance contacts so that the correct D.C. current is passed through the D'Arsonval movement to keep the meter in balance. This D.C. current is, therefore, proportional to the watts, etc., measured by the Kelvin Balance. This D.C. current (a few milliamperes) is sent to the dispatcher's station and connected in series through standard D.C. indicating and Integrating or graphic meters (the latter two meters can only be used if permanent wiring is available between stations). All these meters are suitably calibrated to agree with the Kelvin Balance.

In a recent remote metering installation of this type, and using four wire synchronous control, simultaneous readings of voltage and current are obtained from any one of twenty-six D.C. feeders. Two Kelvin Balance meters are used in the substation, one for current, and one for voltage. In the dispatcher's station, besides the keys, two milliampere meters are used, one meter calibrated in amperes, and one in volts.

From the above as a sample installation, the wide field for remote metering will be apparent.

Discussion

Mr. C. F. Publow, H.E.P.C. of Ont.: Mr. Chairman, I have had a little to do with the station of which Mr. Chubbock has spoken. The supervisory equipment has just been placed in service, a few weeks ago. The automatic was placed in service last October. It is almost amazing to see those machines come on. Down at the station we just have a common push-button which starts the operations, and in about half a minute your machine is on the line. With the supervisory, it takes about five seconds longer. The method of starting and bringing it on depends a good deal upon the action of the governor which has been specially designed.

In the station at Dam No. 9, I think we have supervisory control loaded up about as heavy as any that has been installed. The gate-opening indication is information that in a way is not very essential. The operation of the various breakers are essential information that is wanted back by the despatcher, and for that reason we have what is called priority in the supervisors, which allows the more important information to come through ahead of the secondary information. We have the code system, and think it is going to prove entirely satisfactory.

Mr. E. I. Sifton, Hamilton: There is just one question that crops up. What recording is performed when an operation is put through by the operator or Chief Operator, in case of, say, putting a line alive when it should not be? Just what record is put on the books of the Power Department, so that the absolute instant that the man makes a switching operation a record of it could be brought up in Court to show that he had a perfect right to do that operation? Is there anything in the way of recording, other than the ordinary log-sheet which an operator would naturally compile?

Mr. Chubbuck: I would say, Mr.

Sifton, that that would be covered in exactly the same way as you have it done in an ordinary station. Ordinarily you have no record. If you wish to have a record, you can have on the control circuit a little relay which will drop down and give an indication; or you could have a locked relay which could not be reset except by the use of a key after the operation has been recorded.

A.M.E.U. Reports

Auditors' Report

January 26, 1925.

Mr. J. E. Phelps,
President, Association of Municipal
Electric Utilities of Ontario.

Dear Sir:

We beg to advise you that we have audited the cash account of the above Association for the year 1924, and find that the amounts shown on attached statement as being received by the Secretary are in accord with the various entries recorded by the Treasurer—the disbursements are supported by properly authorized vouchers duly passed by President and Secretary, and the cash balance as shown in bank passbook agrees with the cash book.

Statements of Cash Account and Assets and Liabilities are respectfully submitted herewith,

Yours very truly,
(SGD.) W.G. Pierdon,
(SGD.) R. C. McCollum.
Auditors.

RECEIPTS:		
Balance Dec. 31-1923		1,500.96
Membership fees		
Utilities (145)	1,428.00	
Commercial (38)	380.00	1,808.00
Receipts from banquets		
Carls-Rite	448.00	
Clifton	1,225.50	1,703.50
Interest		
On deposits	34.75	
On investments	28.40	63.15
		$5,075.61

DISBURSEMENTS:		
Banquets		
Carls-Rite	591.50	
Clifton	1,588.00	
Entertainment	112.75	2,292.25
Stenographic Reports		314.70
Travelling Expenses		257.37
Printing and Postage		713.84
Officers' Honorarium		250.00
Bank Exchange on Cheques		15.60
Purchase of Victory Bonds		1,027.00
Cash in Bank		204.85
		$5,075.61

ASSETS:		LIABILITIES:	
Dominion of Canada 5½% Victory Loan maturing 1st. Nov., 1934, par value 1,000.00	1,027.00	Membership fee paid in advance	10.00
Interest accrued to Dec. 31, 1924	9.17	Surplus	1,474.47
Cash in Bank	204.85		
1 Lantern and Fixtures	243.45		
	$1,484.47		$1,484.47

Report Re. Affiliation of Ontario Municipal Electrical Association and Association of Electrical Municipal Utilities

In accordance with a resolution passed at a joint meeting of the Executives of the Ontario Municipal Electrical Association and the Association of Municipal Electrical Utilities, at Toronto, on October 9, 1924, that the Secretaries of the two Associations meet and draft a scheme for affiliation to be submitted at the next meetings of the Associations, we have prepared the following, which is submitted for approval:

The affiliation of the Ontario Municipal Electrical Association and the Association of Municipal Electrical Utilities is for the purpose of permitting the two Associations meeting in joint sessions from time to time for the discussion of matters appertaining to the Municipal ownership of Electric Utilities in Ontario.

Each Association will continue to retain its own identity, elect its own officers, and supervise its own finances, according to their constitutions and by-laws.

Each Association will continue to hold separate meetings for the purpose of discussing subjects peculiar to themselves, joining together at the Annual Meeting, and at other times, when feasible, in joint sessions, when matters of mutual advantage are to be considered.

When conventions are so arranged that there will be joint sessions of the two Associations, the social features of those conventions will also be held jointly, and the expenses of the same shared in proportion to the membership of each attending.

The Association of Municipal Electrical Utilities will pay to the Ontario Municipal Electrical Association an annual fee of Twenty-Five Dollars ($25.00) as required by it.

Whenever it is necessary for the Association of Municipal Electrical Utilities to expend money in connection with work, at the request of the Ontario Municipal Electrical Association, such money shall be refunded to it.

All matters of engineering and operation shall be dealt with directly by the Association of Municipal Electrical Utilities, but questions of policy and legislation shall be referred to the Ontario Municipal Electrical Association.

(Sgd.) T. J. HANNIGAN,
Secretary,
Ontario Municipal Electrical Association.

(Sgd.) S. R. A. CLEMENT,
Secretary,
Association of Municipal Electrical Utilities.

Minutes of the Convention

ON Thursday, January 28th., at 1 P.M. prior to the opening session the delegates met for the first Convention Luncheon. This luncheon was held jointly with the Ontario Municipal Electrical Association and the Electric Club of Toronto, when Profesor A. T. De Lury, Dean of the Faculty of Arts of the University of Toronto, gave an address on Scientific Education which was very much appreciated by all present.

The first session of the Convention was called to order at 2.30 P.M. by the President, Mr. J. E. B. Phelps, who gave a short address of welcome and of appreciation of the honor conferred upon him by the Association in having placed him in the Chair for the past year. The Secretary then presented the Auditors' report and read the following letters:—

A letter from Mr. E. V. Buchanan in reference to the question of extending the meter re-seal period and the appointment of a successor to Mr. Higman.

A letter from the Border Chamber of Commerce, Windsor, and another from the Bigwin Inn asking the Association to hold its Summer convention at those places.

The latter two letters were referred to the Executive Committee.

The names of Messrs. Thos. F. Howlett, F.B. Shand, J. S. Parker and E. S. Frost were presented for election as Associates.

It was moved by Mr. H. O. Fisk and seconded by Mr. E. V. Buchanan.

That the persons whose names were given by the Secretary be elected as Associates. Carried.

Referring to a Notice of Amendments to the by-laws of the Association, it was moved by Mr. O. H. Scott and seconded by Mr. J. J. Heeg:

That the by-laws of the Association be amended as follows:—

Section 1, Clause (c)

Delete the Schedule of Class "A" representation as shown in this clause and insert instead the following schedule:—

Less than 1,000 consumers	— 1 Class "A" delegate
1,001 to 2,500 "	— 2 " " delegates
2,501 to 5,000 "	— 3 " " "
5,001 to 10,000 "	— 4 " " "
10,001 to 50,000 "	— 5 " " "
Over 50,000 "	— 6 " " "

Section 5, Clause (d)

Insert after the word "President" the words "and the President of the Ontario Municipal Electrical Association." Carried.

Affiliation of the Ontario Municipal Electrical Association with this Association as outlined in a report by Secretaries of the two Associations on this matter was then discussed and it was moved by Mr. V. S. McIntyre and seconded by Mr. J. G. Archibald:

That the report of the Secretaries of the Ontario Municipal Electrical Association and the Association of Municipal Electrical Utilities outlining a scheme for affiliation be adopted and included in the by-laws of this Association. Carried.

Referring to the Auditors' report, it was moved by Mr. J. E. Skidmore and seconded by Mr. E. V. Buchanan:

That the Auditors' report for the year 1924 be adopted. Carried.

In reply to the letter from Mr. Buchanan, Mr. W. P. Dobson outlined the work that had been done in an attempt to extend the re-seal period of electric meters, and the action that had been taken by Mr. Higman to obtain a revision of the Act. By Mr. Higman's retirement this matter has received a set back and it was deemed advisable that this Association interest itself with the Canadian Electrical Association in the appointment of Mr. Higman's successor and also in the work to be carried on by the Department at Ottawa.

The following resolution was moved by Mr. O. H. Scott and seconded by Mr. E. V. Buchanan:—

Whereas Mr. O. Higman, Director of Electricity and Gas Inspection Department of the Interior, has retired after many years of distinguished public service, and whereas the appointment of his successor is now under consideration, and whereas, in the opinion of this meeting, it is of fundamental importance that the functions of this branch of the department be enlarged to enable it to be of greater service to the electrical industry and to the public, therefore be it resolved that the Executive Committee of the Association of Municipal Electrical Utilities be empowered to co-operate with other bodies in any action leading towards the accomplishment of this object. Carried.

Mr. J. H. Caster, Assistant Engineer, H.E.P.C. of Ontario, read a paper entitled "Distribution System Engineering". Discussion following this paper was by Messrs. O. H. Scott, H. O. Fisk, H. F. Shearer, J. J. Heeg, C. E. Schwenger, E. R. Lawler and C. W. Baker.

It was moved by Mr. V. S. Mc-

Intyre and seconded by Mr. E. H. Caughell:

That a very hearty vote of thanks be extended to Mr. Caster for his valuable paper. Carried.

The scrutineers then made their report of the election of officers and the following were declared elected for 1925:—

President—Mr. V. S. McIntyre.

Vice-President—Mr. R. H. Starr.

Secretary—Mr. S. R. A. Clement.

Treasurer—Mr. G. J. Mickler.

Directors—Mr. J. G. Archibald, Mr. O. H. Scott, Mr. W. R. Catton.

District Directors:

Niagara District—Mr. H. G. Hall.

Central District—Mr. C. A. Walters.

Georgian Bay District—Mr. J. R. McLinden.

Eastern District—Mr. R. J. Smith.

Northern District—Mr. T. W. Brackinreid.

Mr. V. S. McIntyre, the President elect, gave a short address thanking the Association for the honor it had conferred on him and announced a meeting of the Executive Committee to be held on Friday morning, January 30th.

Mr. L. B. Chubbuck, Staff Engineer, Canadian Westinghouse Company, Hamilton, gave a paper on "Automatic sub-stations and Supervisory Control." Mr. Chubbuck illustrated his talk by lantern slides and demonstrations using supervisory control equipment on display in the Convention room. Discussion following this paper was by Messrs. C. F. Publow and E. I. Sifton.

It was moved by Mr. E. I. Sifton and seconded by Mr. O. H. Scott:

That a hearty vote of thanks be extended to Mr. Chubbuck for his paper which was considered one of the most interesting that has been read before the A.M.E.U. Carried.

The session adjourned at 6.05 P.M.

At 6.30 p.m. the Association met with the Ontario Municipal Electrical Association for the Convention dinner when Sir Adam Beck was the guest of the evening. The President, Mr. J. E. B. Phelps introduced Sir Adam, who addressed the Association on the financial position of the Commission for the year 1924, being given a very hearty reception. Following this Mr. F. A. Gaby spoke elaborating on Sir Adam's remarks, giving details of the 1924 finances and operation of the Commission. Mr. C. A. Maguire, President, Ontario Municipal Electrical Association, congratulated the Speakers of the evening and expressed an appreciation of the work that has been done by Sir Adam Beck in the public interest.

Mr. V. S. McIntyre moved a vote of thanks to C.N.R.T. and C.F.C.A. broadcasting stations and to the Canadian Westinghouse Company in arranging to broadcast the proceedings of the evening and also to the other broadcasting stations of similar wave length who were standing by during that time. This resolution was seconded by Mr. T. J. Hanningan.

The second session of the Convention was called to order at

10 A.M. on January 29th., by Mr. C. A. Maguire, President, Ontario Municipal Electrical Association. This was a joint session of the O.M.E.A. and the A.M.E.U. In opening the session Mr. Maguire addressed the Associations on the Chicago Water Diversion.

Mr. F. A. Gaby, Chief Engineer, H.E.P.C. of Ontario, gave an address on the Construction of the Works of the Commission, after which he answered questions of a number of the delegates.

The following resolutions were then presented. Moved by Mr. W. K. Sanderson and Seconded by Mr. A. B. Scott:—

That this meeting urges the Hydro-Electric Power Commission of Ontario to secure legislation at the coming session of the Legislature to enable the Municipalities to guarantee bonds of the Hydro-Electric Power Commission for purposes of power development, construction of generating plants, transmission lines and including steam plants. Carried.

Moved by Mr. E. V. Buchanan and Seconded by Mr. T. J. Hannigan:—

That this meeting urges the Hydro-Electric Power Commission to prepare a short pamphlet setting forth the facts in connection with the coming power shortage, so that the public may be roused to the seriousness of the situation. Carried.

The session adjourned at 12 o'clock noon for the second Convention luncheon, when Mr. Charles Downey, Toronto, was the entertainer. Mr. Albert David, Toronto, also contributed by singing a number of songs. The musical arrangements of both of the Convention luncheons and the Convention dinner were under the direction of Mr. A. M. Ewart of the H.E.P.C. of Ont.

The third session was called to order at 2.30 P.M. when Mr. C. E. Schwenger read a discussion on "Aerial Lead Covered Cable Distribution."

Mr. Geo. G. Cousins, Assistant Laboratory Engineer, H.E.P.C. of Ontario, read a paper on "Illumination and Lighting Equipment," which was illustrated by lantern slides. Discussion following this paper was by Mr. E. V. Buchanan. It was moved by Mr. M. B. Hastins and seconded by Mr. E. V. Buchanan:

That a hearty vote of thanks be extended to Mr. Cousins for his paper. Carried.

Mr. I. B. Smith, Illumination Engineer, Toronto Hydro-Electric System, read a paper on "Practical Illumination." In moving a vote of thanks to Mr. Smith for his paper, Mr. G. J. Mickler drew attention to the desirability of the Utilities establishing industrial lighting departments to assist industrial establishments and stores in installing proper lighting. The motion being seconded by Mr. H. O. Fisk, was duly carried.

The President then referred to the approaching marriage of Miss Marion Beck, daughter of Sir Adam Beck and the desirability of the two Associations contributing

towards a present for the wedding. It was moved by Mr. C. A. Maguire and seconded by Mr. T. W. McFarlane:—

That the matter of purchase of a wedding present for Miss Marion Beck be left to the Executives of the two Associations. Carried.

At the request of the President, Mr. G. J. Mickler then introduced Mr. C. J. Burton, Appliance Chief, Detroit Edison Company, Detroit, who gave a talk on "Servicing Electrical Appliances." Discussion following Mr. Burton's address was by Messrs. E. V. Buchanan, H. O. Fisk, J. G. Jackson, F. T. Stocking, E. R. Lawler, G. J. Mickler, A. W. J. Stewart and G. W. Blay. It was moved by Mr. A. W. J. Stewart and seconded by Mr. G. W. Blay:

That a vote of thanks be extended to Mr. Burton for his interesting talk. Carried.

Mr. A. W. J. Stewart, Sales Director, Toronto Hydro-Electric System, read a paper on Co-operation between Contractors - Dealers and Hydro Shops." Discussion following this paper was by the President, Messrs. E. W. Tobin, E. V. Buchanan, C. J. Burton and S. L. B. Lines.

It was moved by Mr. D. J. McAuley and seconded by Mr. E. V. Buchanan:

That a vote of thanks be extended to Mr. Stewart for his paper. Carried.

Mr. G. J. Mickler read a paper on "Allocation of Advertising Expense by a Large Electric Interest." Discussion following this paper was by Messrs. R. C. McCollum and E. V. Buchanan.

It was moved by Mr. E. V. Buchanan and seconded by Mr. J. G. Archibald:

That a vote of thanks be extended to Mr. Mickler for his paper. Carried.

The President spoke a few words of appreciation of the work done by the various committees in arranging for the Convention.

It as moved by Mr. E. V. Buchanan and seconded by Mr. C. T. Barnes:

That a vote of thanks be extended to the President who is retiring at this time and who has so ably filled the Chair for the past two years; also to the Committees who have had charge of the arrangements for the Convention. Carried.

The Register shows the attendance at the Convention to have been as follows:—

Class "A" delegates	—91
Class "B" "	—28
Commercial "	—78
Associate members	—37
Visitors	—18
Total	—252

There were 212 at the Convention luncheon on the first day and 231 on the second day: 284 were present at the Convention dinner.

Minutes of Executive Committee Meeting

A MEETING of the Executive Committee was held at the office of the Hydro-Electric Power Commission on Friday, January 30, 1925, being called to order at 10.00 A.M. by the President, Mr. V. S. McIntyre. Other members of the Executive Committee present were Messrs. J. E. B. Phelps, O. H. Scott, W. R. Catton, J. G. Archibald, G. J. Mickler, H. G. Hall, C. A. Walters, J. R. McLinden, R. J. Smith, T. W. Brackinreid and S. R. A. Clement.

The meeting was called for the purpose of naming the members of the various committees for the year 1925, and considering such other matters as needed attention. The Committees for 1925 are as in the following resolutions:

Moved by Mr. O. H. Scott and seconded by Mr. J. E. B. Phelps:

That the Papers' Committee consist of Messrs. W. R. Catton, Brantford, (Chairman); E. V. Buchanan, London; P. B. Yates, St. Catharines; C. E. Schwenger, Toronto; A. B. Cooper, Ferranti Meter and Transformer Co., Toronto, and R. T. Jeffrey, H.E.P.C. of Ont., Toronto. Carried.

Moved by Mr. J. G. Archibald and seconded by Mr. R. J. Smith:

That the Convention Committee consist of Messrs. R. H. Starr, Orillia, (Chairman); J. E. Teckoe, Niagara Falls; T. R. C. Flint, Toronto; H. C. Barber, Standard Underground Cable Co., Toronto; W. N. Elliott, N. Slater Co., Hamilton; G. S. Stewart, Canadian General Electric Co., Toronto; J. A. Daly, Northern Electric Co., Toronto, and J. J. Jeffrey, H.E.P.C. of Ont., Toronto. Carried.

Moved by Mr. J. R. McLinden and seconded by Mr. H. G. Hall:

That the Regulations and Standards' Committee consist of Messrs. O. H. Scott, Belleville, (Chairman); J. J. Heeg, Guelph; J. R. McLinden, Owen Sound; R. J. Smith, Perth; W. P. Dobson, H.E.P.C. of Ont., Toronto, and A. G. Hall, Electrical Inspection Dept., Toronto. Carried.

Moved by Mr. T. W. Brackinreid and seconded by Mr. C. A. Walters:

That the Committee on Accident Prevention and Health Promotion consist of Messrs. H. G. Hall, Ingersoll; (Chairman); R. H. Starr, Orillia; T. W. Brackinreid, Port Arthur; E. M. Ashworth, Toronto; F. C. Adsett, Trenton; T. C. James, S. B. Iler and Wills Maclachlan, H.E.P.C. of Ont., Toronto. Carried.

Moved by Mr. R. J. Smith and seconded by Mr. J. G. Archibald:

That the Merchandising Committee consist of Messrs. J. E. B. Phelps, Sarnia, (Chairman); O. M. Perry, Windsor; E. V. Buchanan London; E. W. Tobin, Stratford; W. H. Childs, Hamilton; O. H. Scott, Belleville; A. B. Scott, Galt; A. W. J. Stewart, Toronto; J. J. Heeg, Guelph; A. Sauder, Kitchener; H. F. Shearer, Welland, and G. J. Mickler, H.E.P.C. of Ont., Toronto. Carried.

Moved by Mr. O. H. Scott and seconded by Mr. C. A. Walters:

That the Rates' Committee consist of Messrs. J. G. Archibald, Woodstock, (Chairman); P. B. Yates, St. Catharines; E. I. Sifton, Hamilton; E. M. Ashworth, Toronto; H. O. Fisk, Peterboro; J. G. Jackson, Chatham; E. V. Buchanan, London; J. J. Heeg, Guelph; A. B. Scott, Galt; Geo. Grosz, Waterloo; O. M. Perry, Windsor; E. J. Stapleton, Collingwood; C. C. Folger, Kingston, and all of the members of the 1925 Executive Committee. Carried.

Moved by Mr. H. G. Hall, and seconded by Mr. J. E. B. Phelps:—

That the Auditors be Messrs. W. G. Pierdon and R. C. McCollum, H.E.P.C. of Ont., Toronto. Carried.

It having been suggested that the Association hold its Summer Convention during a boat trip to Port Arthur and return, Mr. F. D. Goeghegan, General Passenger Agent, Northern Navigation Company, outlined to the Committee the proposition offered by his Company. The Secretary was instructed to obtain from the membership the general feeling concerning taking the trip and the probable number that would attend. He was also asked to obtain rates for such a trip from other companies.

The Secretary also presented communications from the Border Chamber of Commerce, asking the Association to go to Windsor; and from the Bigwin Inn, Lake of Bays, and from the Niagara Falls' Chamber of Commerce, who also extend invitations. These are being held until the next meeting of the Executive Committee when Summer Convention arrangements will be considered.

Messrs. W. P. Dobson and S. L. B. Lines then spoke of the matter of extending the re-seal period of meters which had been under consideration by Mr. Higman, but had received a set back, due to Mr. Higman being retired from the office of Director of the Department of Electricity Inspection at Ottawa. A resolution drawn up and adopted by the Meter Committee of the Canadian Electrical Association was read, being as follows:

The President & Executive,

Canadian Electrical Association.

Gentlemen:

Your Meter Committee in business session on January 22nd., 1925, in Toronto, drew up and adopted unanimously the following resolution dealing with the Dept. of Electricity Inspection at Ottawa.

(1) In view of the fact that Mr. Higman, the late Director, is now on the retired list and that so far no permanent appointment has been made to fill his position, that active steps be taken to make sure that the man appointed has considerable technical and executive ability.

(2) That under the direction of a suitable man the Standardizing Laboratory be organized along similar lines to the Bureau of Standards at Washington or the National Physical Laboratory in England.

(3) That our experiences with this Department in the past show

that it would be in the interests of the C.E.A., the Canadian Gas Association, the Canadian Manufacturers' Association and the Municipal Electrical Association to use their concerted effort to have the appointment made of a man capable of making this department one which we would be proud to acknowledge as a Canadian Standards Laboratory

(4) Under the Electricity Inspection Act, 1907, the fees charged for sealing meters are to be such as to cover the expenses of the Department, and at the present time the yearly surplus from these fees is considerably in excess of this requirement, so that there should be no question of being able to suitably remunerate a qualified Director and assistants.

(5) In view of the above we would request that our Executive actively interest themselves in this matter immediately as the appointment is to be made to this position shortly.

In accordance with the resolution adopted at the Convention on the 28th., it was moved by Mr. O. H. Scott and seconded by Mr. R. J. Smith:

That Messrs. V. S. McIntyre and W. P. Dobson be appointed a Committee to act with the Canadian Electrical Association with the approval of the Ontario Municipal Electrical Association, in actively interesting themselves in the appointment of Mr. Higman's successor. Carried.

Further business taken up by the meeting was as follows:

Moved by Mr. J. E. B. Phelps and seconded by Mr. W. R. Catton:

That Messrs. G. J. Mickler and A. S. McCordick be appointed a Committee to obtain a suitable wedding present for Miss Marion Beck, the cost not to exceed $100.00, this Association to pay all of the cost in excess of $50.00. Carried.

It was suggested that at the coming Conventions there be a Committee whose duty would be to get the members into the various sessions promptly.

Moved by Mr. W. R. Catton and seconded by Mr. J. E. B. Phelps:

That the Secretary and Treasurer be paid amounts the same as had been done the previous year. Carried.

The advisability of holding a meeting of the Rate Committee at an early date was considered and it was moved by Mr. W. R. Catton and seconded by Mr. T. W. Brackinreid:

That the Executive of the O.M.E.A. and the A.M.E.U. Rate Committee meet to discuss the revision of rates, the time and place to be arranged by the Chairman of the Rate Committee. Carried.

The meeting was adjourned at 12.10 P.M.

Other Convention Papers and Discussions will appear in the March Bulletin

Grounding of Electric Machinery

By Warren Hilleary, Superintendent, Royal Indemnity Company, New York

THE following discussion of the grounding of electrical-equipment frames is intended to include motors, dynamos, transformers and all other equipment, whether used in connection with electric elevators or other driving or driven machinery:

The argument in favor of insulating frames is that such insulation safeguards the machines and assists in maintaining service. Not to insulate them but to ground them, is said to militate against the safety of machines and to interrupt the service. Grounding is thought to increase the stress on the insulation between the electric circuit and frame, the voltage to ground being taken entirely by the insulation of the electric circuit. With the frame insulated, the voltage to ground is shared by two layers of insulation in series, the layer between circuit and frame and the layer between frame and ground. Accidental grounds from failure of insulation appear to be more likely to occur in machines with grounded frames than in machines with insulated frames. With a grounded frame damage may result if there is an accidental ground or a ground connection made in the external circuit. If the frame of the machine were insulated, no damage might result.

Grounding of Frames Increases Probability of Damage.

In general, the grounding of frames increases the probability of damage by accidental grounds, and the higher the voltage the greater this danger. The principal reason for this is that in low-voltage machines and their wiring the factor of safety of the insulation is high under normal operating conditions; in high-voltage machines and their wiring the factor of safety of insulation is generally less than in the lower-voltage machines.

In alternating-current apparatus the high factor of safety in the secondary or low-voltage insulation is offset to a certain extent by ground connections in the external circuit. In the primary circuits the total voltage is in many instances shared by the insulation of lines and machines in series. The insulation of the secondary circuits is less subject to damage by surges from high-frequency electrical disturbances than is the insulation of the primary circuits. However, there is great disparity between primary and secondary machines and lines as regards the factor of safety of insulation, and the insulation of primary circuits is always exposed to damage from electrical causes. Hence, with grounded frames primary machines are the most likely to be damaged.

Where an accidental ground occurs to a grounded frame, the resultant current flow to earth is the more destructive the higher the voltage of the machine. This is because usually the higher the voltage the larger the kilowatt capacity and hence the greater the power for destruction. Insulating frames, therefore, appeals strongly to many as a means of safeguarding their property and service. Power-plant machinery is considered by some to be more than ordinarily susceptible to the kind of damage described.

Life Hazard Increases.

With insulated frames the life hazard increases as the voltage increases. It is possible, with insulating platforms and other devices, to lessen danger from this source, and the faithful observance of their use will result in a great degree of freedom from accidents. At the same time safety here depends upon individual memory and carefulness, and in a case where the frame of a machine is in a safe condition for months, or even years, the observance of precautions in respect to it inevitably becomes lax.

It is evident that the best degree of safety lies in preventing a rise of potential between frame and ground by grounding the frame. Such grounding should be extended to machines of all voltages because there is great uncertainty as to the maximum voltage that is not dangerous to life. An exception may be made in the case of machines operating on lines supplying power at 150 volts or less, and which are not liable to contact with high-voltage lines. An exception may also be made in the case of machines where it is necessary to work on brushes when they are alive. But no exception can be made when machines of any kind operate in damp places or where there is an explosive gas or a combustible mixture of air and starch dust, flour dust, coal dust, etc. The frames here should in every case be grounded.

Factories in Favor of Grounded Frames.

In support of grounded frames there are several points that may be urged, in addition to the safety secured to attendants. In the first place it is questionable whether insulating the frames decreases the stress on the insulation of the circuit to an appreciable degree. For, in order that such insulation may reduce the stress on the insulation of the circuit, it is necessary that the insulation resistance between frame and ground be comparable in magnitude with that between circuit and frame. Unless it is, the benefits derived from insulating the frame are negligible so far as voltage stress on insulation is concerned.

In fact, if the resistance of the layer of insulation between frame and ground is low in comparison with that between electric circuit and frame, the frame might as well be grounded. There are, of course, certain types of machines, such as old-type arc machines, in which the resistance of the insulation be-

tween electric circuit and frame is low, and here, insulation between frame and ground would be of assistance, but such cases are exceptional.

INSULATING OF FRAMES CONDUCIVE TO CARELESS OPERATION.

In the second place, insulating frames is conducive to carelessness of operation, in that the machines can be operated with an accidental ground to the frame or armature core, contrary to sound engineering practice. It enables the time of making repairs to be put off, and if the time of repairing can be put off at all, it will in many cases be postponed until something further happens, usually a second ground in the machine, which may lead to damage of a more severe character than that produced by an accidental ground to a grounded frame. With insulated frames accidental grounds are likely to develop without the knowledge of the attendants unless special means are taken to detect them. This is not often done, and incipient grounds may exist unsuspected, until a burn-out of the machine or a fatal, or at least serious accident discloses the faulty condition.

Without appreciably increasing the expense of operation, machines with grounded frames can be safeguarded to an even greater extent than would ordinarily be the case with insulated frames. For, with grounded frames, devices continuously in operation for detecting accident grounds can be used, and in addition tests can be made periodically, which will show any progressive weakening of insulation. Insulation failures can thus be detected, searched out and removed before anything serious happens. In the meantime the grounded frames guarantee safety to attendants from accidental grounds which form without warning. There is, in general, no advantage to be obtained in operating machines with insulated frames that cannot also be had with grounded frames if a reasonable degree of care is used. With grounded frames there is the additional advantage of reducing the accident and life hazard, which is one of the most important considerations.

—*Power.*

ERRATUM.

In the Bulletin for January 1925, page 28, the heating equivalent of electricity is shown as "3.412 B.t.u. per kilowatt-hour". This should have been stated "3412 B.t.u. per kilowatt-hour".

List of Electrical Material, Devices and Fittings

Approved by The Hydro-Electric Power Commission of Ontario in January 1925.

Appliances

The Burrowes Manufacturing Company, 611 King St., W., Toronto.

"Apartment" electric oven.

* * *

The Fitzgerald Manufacturing Company, Torrington, Conn.

Electric Curling Iron, "Star-Rite".

* * *

Beach Foundry Limited, Ottawa, Ont.

Electric Cooking Range, Cabinet type, Style E.304;

Low oven type, Style E.104. "Beach".

* * *

Wilson & Cousins Limited, 33 & 35 McCaul St., Toronto.

Electrically-operated Carbonators.

* * *

Canadian General Electric Company, Limited, Hotpoint Works Division, Stratford, Ont.

Portable Air Heaters. "Hotpoint".

Electric Soldering Iron, Cat. No. L.20.

Electric Bake Ovens and Heavy Duty Cooking Devices, Cat. Nos. T7, G1, G2, G3, R15, R16, B150, B200, B201, B202, B2012, B220, B300.

* * *

Renfrew Electric Products Limited, Renfrew, Ont.

Percolators, pot and urn types, Cat. Nos. 73 and 71.

* * *

Wayne Tank and Pump Co. of Canada, Limited, 165-187 Dufferin St., Toronto.

Motor-operated Air Compressors, Two Stage, No. 2000; Single Stage, No. 2500.

* * *

The Gurney Foundry Company Limited, 500 King St., W., Toronto, Ont.

Electric Ranges, low oven, Style No. 501.

* * *

*Ritter Dental Mfg. Co., Inc., Rochester, N.Y.

Dental Equipment Stand, "Ritter Tri-Dent".

* * *

*Marshall Electric Co., 3225 Locust St., St. Louis, Mo.

Rectifiers.

* * *

*Fore Electrical Mfg. Co., Inc., 5255 N. Market St., St. Louis, Mo.

Rectifier, Type MF.

* * *

*Falls Equipment Co., Inc., The, 1313 Main St., Niagara Falls, N.Y.

Electric Water Heaters, Circulation type.

* * *

*St. Thomas Metal Signs, Ltd., St. Thomas, Ont.

Electrically illuminated display signs.

* * *

Fixtures

ADAMS-CRUDEN-ADAMS Co., 914-16 Dufferin St., Toronto.

Portable Electric Lamps, "A.C.A. Co."

* * *

MORRIS ART POTTERY Co., 17 Carlaw Avenue, Toronto.

Portable Electric Lamps, "Grooco".

* * *

Fittings

MESSERVEYS INDUSTRIES, INC., 258 Washington St., Buffalo, N.Y.

Current Taps.

* * *

*LANGLEY ELECTRIC MFG. Co., LTD., 677-79 Notre Dame Ave., Winnipeg, Man.

Cabinets and Cut-out Boxes—sheet metal.

* * *

*ARROW ELECTRIC Co., THE, Hartford, Conn.

Medium Base Receptacles (as listed on Underwriters' Laboratories card, dated November 23, 1923).

* * *

*BEAVER MACHINE & TOOL Co., INC., 625-45 N. Third St., Newark, N. J.

Fuseless Attachment Plugs, Cat. No. F.1, J-1, J-21 "Beaver".

MAGNUS ELECTRIC Co., 787-95 East 138 St., New York, N.Y.

Fuseless Attachment Plugs Cat. Nos. 1, 22, 32, 48. "Magnus Plugall", Cat. No. 95.

* * *

Switches

*A. G. MANUFACTURING Co., Seattle, Wash.

Enclosed Switches (as listed on Underwriters' Laboratories card, dated June 24, 1924.)

Panelboards, Types "S.B.D.F." and "D.B.D.F."

Stage Type "D.B.D.F."

* * *

Miscellaneous

*BEAVER MACHINE & TOOL Co., INC., 625 N. Third St., Newark, N.J.

Pendent Switches (as listed on Underwriters' Laboratories card, dated December 30, 1924.

* * *

*CANADA WIRE AND CABLE Co. LTD., Mfr., Toronto, Ont.

Fixture Wires—slow-burning.

* * *

*These devices are under the Underwriters' Laboratories re-examination or label service.

Re. Municipal Populations

To enable The Bulletin to give as nearly as possible the correct populations of the Hydro Municipalities as shown in the lists on the inside of the cover, it would be of considerable assistance if the Municipal Officials advise of any corrections that should be made.—Editor.

THE BULLETIN

Published by
HYDRO-ELECTRIC POWER COMMISSION
of Ontario

190 University Avenue
Toronto

Subscription Price $2.00
Per Year

Co-operation Between Contractor-Dealers and Hydro Shops

By A. W. J. Stewart, Sales Director, Toronto Hydro-Electric System

(Paper read before Association of Municipal Electrical Utilities at Toronto, January 29, 1925.)

THE form of co-operation by Hydro Shops which has been of most value to Contractor Dealers is probably general advertising. In most districts the Central Stations have been the pioneers in the advertising of electricity and electrical appliances. Advertising of this kind has very often been done by the Central Stations before there were any electrical dealers in the territory who were interested in the sale and use of appliances.

In many cases the Central Stations have not gone into the appliance business because they wanted to carry on merchandising, but because somebody had to lead the way in developing the market for appliances to build up the Central Station load. In practically every advertisement run by the Toronto Hydro Shops a reference is made to the fact that the appliances referred to may be purchased at the shops of good electrical dealers as well as at the Hydro Shops. The wording of this reference is changed from time to time; for example, one reference reads "Visit the Toronto Hydro Shops or any good electrical dealer and see how modern electrical appliances lighten the work of the home."

At one time it was customary in Hydro advertisements to mention some of the goods as Hydro appliances. For instance, an advertisement might refer to a Hydro toaster or a Hydro vacuum cleaner. One of the Dealers suggested that this might give the impression that the term "Hydro appliances" referred to articles specially made for the Hydro Shops and which were

CONTENTS

Vol. XII. No. 3

MARCH, 1925

Commercial Section
A.M.E.U. Convention

not obtainable at other electrical stores. Following this suggestion the advertisements were changed so that now no appliances are referred to as Hydro appliances but reference is made to them as electric washers or electric vacuum cleaners and so on.

Advertisements of the Toronto Hydro Shops are largely educational and are planned to sell the idea of letting Hydro help with the housework rather than to sell any particular make of appliance. No Contractor Dealer in Toronto carries on this class of advertising but they all benefit from Hydro advertisements. Advertising of this kind is also a real service to Hydro customers because without it many of them would not know of the many labor saving electrical appliances. That this advertising is still necessary is illustrated by the fact that in a recent survey of one of the best districts in Toronto, it was found that in spite of volumes of advertising by many companies, 30% of the homes in a very high class district still have no vacuum cleaners. The percentage would be much higher in an average district.

The electric ironer is a good example of an appliance requiring advertising of an educational character. As far as I know no Contractor Dealers in Toronto are advertising these. Considerable advertising space was devoted to ironers by the Toronto Hydro Shops until two or three months ago when the advertising of ironers was discontinued because of power conditions.

Electric Service League Red Seal Wiring.

The Toronto Hydro-Electric System helped to organize the Electric Service League of Toronto and the System co-operates with the League in the development of electrical business. The Electric Service League membership is made up of representative electrical Manufacturers, Jobbers, Contractor Dealers and the Central Station. The co-operation of the System in League work is a very considerable help to the Contractor Dealers. One of the chief activities of the League is to promote the idea of better wiring, particularly for residences. Considerable success has attended the Electric Service League Red Seal campaign on house wiring. The idea originated with the Manager of the Toronto League and is being taken up by the electrical interests in the United States. The Society for Electrical Development refers to

it as the best selling idea developed in the industry in many years. No wiring Department is operated by the Toronto System so that improvements in the wiring standard help the Contractor Dealers to sell better wiring jobs, thereby increasing their income, while at the same time offering their customers a real service because there is no doubt that any person who sells a better wiring job to a prospective builder of a house renders a service to the person who is to live in the house.

The activities of the League have resulted in a considerable improvement in the house wiring standard in Toronto, as many builders are installing adequate wiring in all the houses they build. The public are gradually being educated to look for proper wiring when they contemplate building, buying or renting houses. This campaign for better wiring, which is strongly supported by the Toronto System, has considerably increased the wiring business of the Contractor Dealers in addition to giving the dealers an opportunity to sell electrical appliances and equipment to the owners of the houses in which they have installed up-to-date wiring.

Price Maintainance.

The Toronto Hydro Shops have constantly refrained from putting on price cutting campaigns. It has been the policy to handle only appliances which have been approved by the Hydro-Electric Power Commission of Ontario. For instance, the sale of cloth warming pads was discontinued some years ago when the Commission decided to not give approval on these. Handling only approved and standard appliances, it has been the policy to maintain established resale prices, so the Dealers have had no cause for complaint in this regard. Following out this policy, the Toronto Shops have refrained from offering premiums in connection with special sales, as the offering of premiums is undoubtedly a form of price cutting. One of the essentials for the success of a premium-giving sale is a considerable amount of advertising. In Toronto where advertising rates are high the small dealer is not in a position to do the necessary advertising to make a sale of this kind a success and if premium-giving sales were carried on by the Toronto Hydro Shops, it would be a form of competition which the small dealer would find it hard to meet. For this reason the present policy of the Toronto System is to have no campaigns of this kind.

Range Sales and Installation.

The sale of electric ranges in Toronto was almost negligible until the Toronto Hydro Shops began advertising and to some extent pushing them. When this effort was well under way, there were isolated Contractors who suggested that the range business was being taken away from the Contractor Dealers. As a matter of fact the Contractor Dealers had never had the range business and the advertising by the Toronto Hydro Shops had not switched it from the Dealers but

had created the business which had not previously existed. A little over a year ago the Management gave instructions that range advertising was to be discontinued and the Toronto Shops are still in the position of being unable to advertise ranges. The result of this has been that range sales have dropped from 1561 in 1923, when ranges were advertised, to 994 in 1924, when there was no range advertising. As a contrast to the previous attitude of the Contractor Dealers it is interesting to note that one of the leading Toronto Dealers advised a short time ago that Contractor Dealers are finding it very hard to sell electric ranges on account of the fact that the range advertising by the Toronto Hydro Shops has been discontinued.

One of the main helps in selling electric ranges has been the quoting of a flat price for installation. The simplest way to have carried out this policy would have been, as is done in many cases, to call for tenders and to hand over all the jobs for a definite period to one Contractor at a pre-arranged price. As this method did not seem to suit the Toronto Contractors, it was decided that the Hydro Shops should take the chance as to the cost of each job by quoting a flat price to the customer and calling for tenders on each separate job. It will be seen at a glance that this entails more detail work on the part of the System, but this is another example of the effort to co-operate with the Contractor Dealers in every way possible. The System's flat rate prices are adjusted from time to time so that they exceed the average prices paid to the Contractor Dealers and in this way the prices quoted by Contractors really determine the flat rate prices in effect. In comparing flat rate installation prices for Toronto with those for other municipalities, it should be borne in mind that in Toronto the minimum service is 3—No. 6 wires and it is very seldom that wires even this small are used.

"Reduced Price Range Campaign."

Some Contractors have suggested that if they had a line of goods not sold by the Hydro Shops they would be in a position to carry on the merchandising in that line to better advantage. A recent experiment along this line is very interesting. One of the Range Manufacturers decided to give Contractor Dealers an opportunity of proving that they could sell a line to better advantage if the same goods were not on sale at the Hydro Shops. In order to co-operate in this experiment, the Hydro Shops got rid of all ranges of the particular make in question and a special campaign was put on by the Manufacturer in connection with a number of Contractor Dealers in the City. Ranges were sent on consignment to Dealers who did not wish to pay for them. The Manufacturer gave free window dressing service to the Dealers and also arranged that the ranges were to be sold at a reduced price during the campaign. All newspaper advertising was paid for by the Manufacturer and each advertisement carried the

names of Dealers from whom the specially priced ranges could be purchased. To all appearances the Dealers were getting everything that they could have very well asked for and they were spending nothing in connection with the experiment. Without the permission of the Manufacturer it would hardly be fair to give figures of the number of ranges sold, although some of the Dealers during the period of the campaign made no sales at all. It is perhaps sufficient to say that at the close of the campaign the Manufacturers were willing to accept an order for ranges to be sold through the Toronto Hydro-Electric Shops.

Contractors are invited to use the Hydro Shops as sample rooms and a Contractor is perfectly at liberty to bring in a customer and show him the various styles of ranges and other appliances without any obligation on the part of the Contractor or his customer to buy the goods at the Hydro Shop. When the customer has decided on the appliance to be purchased, the Contractor is at liberty to buy it where he pleases but if he decides to purchase it from the Hydro Shop, arrangements will be made to sell the article to a bona fide Contractor at a discount, and if so desired delivery will be made to the customer by the Hydro Shop. The rule in this case, however, is quite definite that if the Contractor is to get any discount, the sale must be made to him and he makes his own arrangements with the customer regarding terms and other details. This is to prevent any possibility of a Contractor claiming commission on a sale made by the Hydro Shops to a customer to whom a Contractor may have tried to make a sale, as it is against the policy of the System to pay commissions in this connection.

The Toronto Hydro-Electric System has recently taken membership in the Toronto section of the Contractor Dealers' Association and by a representative attending the meetings of the Association it is possible to keep in touch with the work being carried on by the Contractors and Dealers and it is also often possible to straighten out difficulties or misconceptions on the part of the Dealers regarding the activities of the System. Arrangements have been made for conferences from time to time between representatives of the System and of the Contractor Dealers' Association for the discussion of problems of mutual interest.

Lists of Contractors in various parts of the City are kept on file at the Toronto Hydro Shops and customers who enquire in connection with electric wiring may obtain the names and addresses of two or three Contractors in their own district from whom they may obtain estimates in connection with wiring. Strict impartiality is carefully enjoined on all employees.

Similarly in the case of customers who enquire for electrical goods not handled by the Hydro Shops, an effort is made to direct them to dealers from whom the goods desired may be obtained.

The policy of co-operation on the part of the Toronto Hydro-Electric System has resulted in a certain feeling of good will on the part of the better Contractor Dealers, who in most cases have a friendly attitude toward the Hydro Shops. This brings about a condition which is to be desired by all concerned as it is much more pleasant to work in harmony with related interests than to have constant friction.

In connection with this subject of co-operation between Hydro Shops and Contractor Dealers, it may be that some of the ideas carried out in Toronto would not be entirely suitable for other places where conditions are different, but in the main the fact still holds that if the Contractor Dealers are willing to co-operate, the Hydro Shops should meet them at least half way.

Discussion

The Chairman: I am sure we are all pleased and instructed with the way in which Mr. Stewart in his paper shows definitely the stand taken by the Toronto Hydro Commission in regard to co-operation with contractor-dealers. Various Hydro municipalities, which operate Hydro shops, have been accused of putting the contractor-dealers out of business, with unfair competition, and all that sort of thing; and it is indeed gratifying to me to see the pains taken by the Toronto Hydro Commission to work in co-operation with the contractor-dealers in this city. I am sure these ideas could be carried to a greater extent in various municipalities.

In the City of Sarnia, which I happen to represent, we have contractor-dealers selling ranges not sold by a Hydro shop; and when a customer comes into our store and mentions a certain make of range or any other appliance which we do not carry, we tell him at once that we do not handle it, and tell him where he can get it. We try to see that the dealer gets a square deal. We are not in direct competition with the contractor-dealers. It is our duty, I think, to try and help them. As municipalities who are selling appliances, we cannot expect to sell all the appliances, any more than in any other line of business. We must expect that somebody else is going to sell something. We owe a deep debt to the contractor-dealers; they hand us a lot of business. They wire a lot of houses and hand over a lot of business to the Hydro; and we get their money. At the same time, they do not have much use for us; there is no doubt about that; but still, I think, we ought to try and educate them to the fact that we do not try to give them unfair competition. We are in the business because we are entitled to be in the business, and we try to give our customers service. Now, is there any further discussion on this paper which is on a very live topic?

Mr. E. W. Tobin, Stratford: Mr. President, may I ask Mr. Stewart

what discount they extend to the contractor-dealer where he makes a sale in your store.

Mr. Stewart: The usual discount is ten percent. but we will deliver the appliance and he has no expense in connection with that part of it at all. He has a straight profit of 10 percent. in addition to any profit which he may make on the wiring which probably goes with the sale.

Mr. Tobin: The contractor-dealer in that case assumes all the responsibility for service?

Mr. Stewart: Oh yes, he is the contractor. Of course we give service on anything which is sold. We agree with London that service at cost does not mean service for nothing.

Mr. Tobin: On repair parts, do you give the same discount to the contractor-dealer?

Mr. Stewart: Yes.

Mr. Tobin: I do not know that I altogether agree with one point. If a customer comes into your shop and mentions something which you have not got, I maintain it is a perfectly legitimate thing to show the customer what you have got. We are in business to sell, and if possible we have to make a profit. The way I look at it is that if we can make a sale, that is our first duty. Our duty is to ourselves first and, possibly, to the contractor second. As far as our attitude is concerned, if we can make a sale we will make it, by fair means. I think it is perfectly legitimate merchandising to make a sale.

Mr. Stewart: Our attitude would be to say to the customer that "Bill Jones, 17 Yonge Street, sells that kind of washing machine. We will be glad to show you ours". But we leave it to the customer. The customer is probably sold to the idea of the machine which the customer has in mind. Very soon there will be no appliances on sale which are not approved.

Mr. E. V. Buchanan, London: I asked Jim Wilson to hold me in my seat, but he will not do it. I do not agree with anything at all, seemingly.

Mr. Stewart has proved one thing very clearly, and that is that the contractor-dealers need our co-operation, because if they did not have it in Toronto they would, apparently, go out of business.

He also talked about a range campaign, where the Hydro shops stayed out and gave the contractor-dealers a free field, and they could not sell any ranges. For the life of me, I do not see why we should maintain a high class show room, like most of the Hydro municipalities do, and then pass our business along to someone further up the street.

Of course, London may occupy a different position from some of the other municipalities, because our Hydro shop was the only appliance store in the city, when appliances were first sold. We did not take any business away from anybody, but we created the demand for these appliances; and there are now twelve contractor-dealers in business. Now, why should they object to our business? I do not believe they do, seriously. We do not cut prices; we maintain the regular prices, and I think it is fair competition.

I would like to ask Mr. Stewart why he does not mention in his advertisements that these appliances can be ob-

tained at the stores of Hardware Dealers.

Mr. Stewart did not tell us how much he has to charge for a range installation so that the contractor may have the job of putting it in and make a profit at the expense of the public which, I believe, is exorbitant.

Then the matter of selling appliances and telling people that we do not keep this appliance, but they will get it down the street—we might as well, when some person comes in and wants a lamp, send them somewhere else, when we sell the Hydro lamp which, we know, is the best lamp in the world. We might as well tell a would be customer that we don't sell the lamp they ask for, that "Tom Jones, at 17 Yonge Street, sells them". It seems to me it is an absurd policy.

Mr. C. J. Burton, Detroit: I may say that I entirely agree with Mr. Buchanan. Of course I am prejudiced, as I am a merchandising man. I am firmly convinced that the merchandising, the selling of appliances, is a legitimate part of the business. If we are in it why not do our best to do business? What is the use of making a big display at considerable expense, and then chase half your business away? It is perfectly all right to maintain your list prices and handle your merchandising department and forget that it is connected with the central station, and do business just as you would if it was an independent store. Do not chase your own business over to a contractor-dealer.

As an illustration, I might say we formerly did not display an electric range in any of our stores in Detroit, and we have half a dozen branches in the city. A customer would come in and ask for an electric range, and we would say, "We do not carry them". They would think it strange, and would ask, "Who does carry them?" and we would give the name of a dealer. We discovered that the customer would go out of our shop and would not go down to the dealer and ask to see an electric range. But the customer would say, "The Detroit Edison does not carry them, I guess there must be something wrong with them". If you are doing business go to it strong. As I said, I look at it from the merchandising standpoint, while others here possibly look at it from the engineering standpoint, which is entirely different.

Mr. S. L. B. Lines, Lincoln Meter Co., Toronto: Mr. Stewart mentioned the "Red Seal". I had an experience which struck me as rather interesting. I spent a Saturday afternoon sauntering around with builders. I did not let them know that I was interested in the electrical industry. One of the first questions I put was "Is the house a Red Seal?" One or two of them asked me what I meant. Another builder said, "Do you think that is any good?" I said, "Yes, it is. I would not buy a house that did not have it on it." He said, "I will go right down and see if I can get it on". You try it and talk to a builder about it. If you do, the Red Seal will be very popular.

Mr. Buchanan: I think there is something on which I am agreed, and that is the Red Seal. I think Toronto should be congratulated upon the Red Seal campaign.

Mr. Stewart: The question is asked why we do not mention hardware deal-

ers, druggists and confectionery stores in our advertisements. All electrical appliances should be bought in a store where the merchant knows what he is selling, knows how to use it, and how it should be used, and knows how to keep it in repair; and therefore we only refer to such dealers.

As to the electrical range campaign, it is only fair to say that we thought we knew how the campaign would turn out, and therefore we acted as we did; and we were very glad to have the opportunity to prove that the Hydro shops handling ranges help the contractors to sell them.

Allocation Of Advertising Expense By A Large Electric Interest

By G. J. Mickler, Sales Dept., H.E.P.C. of Ont.

(Paper read before Association of Municipal Electrical Utilities at Toronto, January 29, 1925.)

AS the question of allocating charges for advertising of different kinds is engaging the attention of a larger number of Hydro Municipalities at the present time, particularly on account of the cost of purchasing and distributing the "Hydro Lamp" bulletin, and the Hydro Calendar, some data on the methods employed by other large Electrical Institutions has been collected for the benefit of Hydro Municipalities.

Broadly speaking, the advertising carried on by an electrical industry may be divided into three classes:

1st. Propaganda Advertising.

Advertising which is designed to create in the minds of the public using electrical energy, for any purpose a feeling of good-will toward the electrical industry, and toward the Central Station acting as a source of supply. This type of advertising results in no direct benefit to the industry, except as may be measured by the satisfaction shown by consumers for the service, and the increased use which these consumers make of the service.

Confidence is established in the Central Station and the electrical industry as a whole by this type of advertising.

2nd. Load-Building Advertising.

Where a Central Station has plenty of power to spare, or is anxious to sell power at a time when more diversity of load is desired, consumers are induced through advertising to utilize this power, by installation of such current consuming devices as will suit the requirements of the Station. Direct benefit to the Central Station through this form of advertising is created by increased revenue from

increased consumption. If the Central Station is not in the merchandising business, the cost of this kind of advertising is purely Promotion of Business Expense. If, however, merchandising is engaged in a proportion of this advertising might be charged against the sale of electrical merchandise through increased sales of commodities using current.

3rd. Appliance Advertising.

The offering for sale of specific lines of appliances, which are sold at a profit.

Appliance advertising may be specific or general. Specific advertising, covering a field, of offering for sale, perhaps with special inducements, certain appliances purely as a commercial enterprise.

General advertising, that which promotes the use of electrical appliances of many types, creating in the minds of consumers the desire to use electricity in the home, and elsewhere, for their greater conveniences. This will result eventually in the purchase of some electrical appliances, either through the Central Station Merchandising Department, or from some other source.

Appliance advertising is of direct benefit to the Merchandising Department because of increased sales of appliances, resulting in increased profits, and also to the Power Section of the Central Station because of increased consumption, due to the use of these appliances, and the cost should be sub-divided as nearly as possible on the basis of benefits received.

Outlining the three classes of advertising as set out above, letters were sent to some of the larger Electrical Interests in the United States and Canada, to find out how they appropriate the expense of advertising as conducted by them, and the following are the answers received:—

Commonwealth Edison Company, Chicago, Ill.

"All of our advertising is charged to General Advertising Account, but expenditures for advertising are analyzed into different divisions, such as Advertising for Electrical Shops, Maintenance of Company Electric Signs, Outdoor Advertising, Newspapers, Show Windows, Magazines, and Miscellaneous Publications, Printing, Direct-by-mail, and Exhibitions.

Advertising for the sale of securities is handled by a separate Corporation, known as the Utilities Securities Company.

Naturally all sales of appliances for use on our lines result in an increase in the output or use of energy, but we do not credit our advertising account directly with such proportionate or estimated amounts."

New York Edison Company, New York, N.Y.

"Although we spend a large sum of money annually in newspaper and other advertising, we do not distribute it, simply charging the entire amount to advertising. It is our opinion that if it seems desirable to charge advertising to such branches of the

business as receive benefit it might be considered that every meter reader, collector, all salesmen and even clerks and office boys are continually creating or charged under that heading distributing good-will—such advertising of course cannot be although it is probably of greater value than money actually spent directly for advertising.

There are some concerns who pro-rate the charge when an ad. includes propaganda for good-will, and also appliances, according to the space devoted to each, although even then the appliance may be responsible for attracting attention to the ad., and the good-will would derive additional benefit on the assumption that without the display the ad. might have been overlooked."

Detroit Edison Company, Detroit, Mich.

"Our advertising has always been very conservative. It consists mostly of two insertions a week in daily papers. This space is devoted entirely to service advertising, such as improving lighting in stores and factories, convenient lighting in residences, other applications of power, and so forth.

In suburban and rural districts we advertise household appliances more frequently than we do in Detroit, but we make no separate allocation of the cost.

We do no propaganda advertising.

Our advertising appropriation is considered a Sales Department Expense, (Sales Department being applied to the Department selling power)".

Winnipeg Hydro, Winnipeg, Man.

"We spent about $....... this year in advertising, half being charged to the Appliance Department, and half to Promotion of Business.

We are pleased to report our advertising has had most excellent results, especially as regards the sale of appliances as this year we shall have a record year.

Last year we had a campaign on our Standby Plant, and Central Heating System, and it was greatly due to these advertisements that we got a good majority when the question was put to the vote of the ratepayers."

National Electric Light Association, New York, N.Y.

Extract from a report of the Merchandising Accounting Committee, 1924:—

"It was agreed that because of different policies existing in several Companies, it would not be practical at the present time to set out a standard treatment as to the charging of the cost of newspaper space, and that the previous decision of the Committee be thereafter rescinded.

It was decided that for the time being at least each Company is to use its own judgment and discretion in allocating advertising expense, bearing in mind that the net result should be in close harmony with the intention of the Committee, to ascertain the relative value of

advertising as a whole to the merchandising operations. It was also decided that on its statement each Company should show the method followed in prorating the expense."

From the above communications it is quite evident that responsible Electrical Interests recognize in the forms of advertising, particularly appliance advertising, benefits to the Industry as a whole, and where Merchandising Shops are in operation the concensus of opinion is that the cost of appliance advertising should not be borne entirely by the Merchandising Department.

If we are to analyze the result of a particular advertisement, advertising say electric ranges, we would find that if this particular advertisement sold say ten ranges, which might otherwise not have been sold, the cost of the advertisement might be $100.00, and might be allocated say half to the Appliance Department, and half to Promotion of Business. If in the operations of the Utility sufficient revenue is received from the sale of current to electric ranges to cover the cost of service, set up a reserve for depreciation of equipment, and to leave a small surplus, the ten ranges sold from this advertisement would in their proportion of that surplus provide undoubtedly sufficient to pay their share of the particular advertisement referred to above, in the first year, but these ranges go on year after year producing enough revenue to cover the expense of service, to provide depreciation, and a small surplus, and after the first year this surplus is not required, for advertising purposes, because most or all of it was provided in the first year. The conclusion we would arrive at, therefore, would be that whatever benefits are derived from the sale of the ten ranges, from the particular advertisement, go on indefinitely, and for that reason a greater share of the cost of this advertisement, than would appear to be just at first analysis should be borne by the Utility as a whole, under the heading "Promotion of Business".

In the "Uniform Classification of Accounts", published by the H. E. P. C., July, 1915, Promotion of Business, under Section C, Advertising, Salaries, Supplies and Expenses, are defined as follows:

> "Charge to this account the salaries of the advertising agent and clerks, and the expense of advertising in newspapers and periodicals, and by circulars, signs, booklets, handbills, and so forth, and all relative items."

From this definition it is clear that in the design of this Accounting System, advertising in its various classes was foreseen and the benefits thereof to the Utility generally acknowledged.

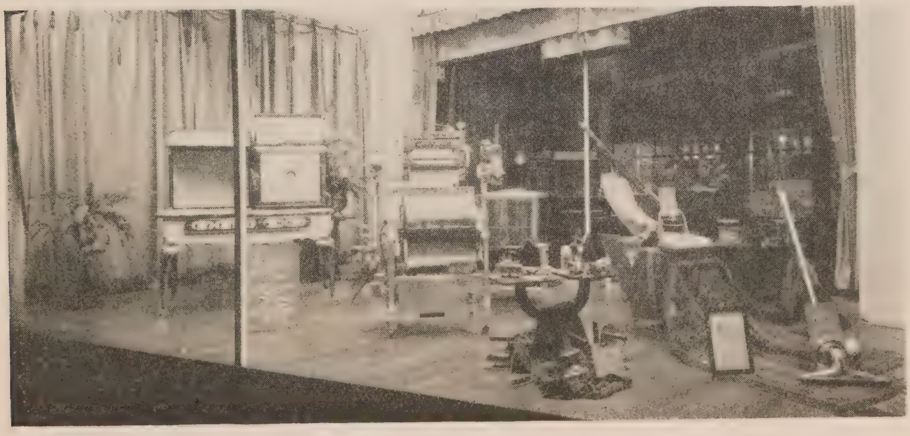
The "Hydro Lamp" bulletin may be classed as a combination of propaganda advertising, load-building advertising and appliance advertising of a general nature, and the cost of its distribution should not be charged directly against the Merchandising Department of any Hydro Municipality.

The "Hydro Calendar" creates good-will among the Hydro consumers in any Municipality toward the Local Utility. As very little direct advertising is contained in the calendar, a large proportion of the cost of purchase and distribution might be classed as Promotion of Business. Certainly not over 33 1/3 percent. of the cost of either the "Hydro Lamp" or "Hydro Calendar" should be charged against the Hydro Shop as part of its Advertising Expense.

In justification of this assertion comparison might be drawn with the advertising expense of an outside electrical shop, competing with the Hydro Shop, and purchasing electrical appliances on the same terms as the Hydro Shop. All the advertising carried on by this competitor in newspaper advertising, direct-by-mail circulars, window displays and so forth must be duplicated by the Hydro Shop when it wants to make a sale. On the other hand all the propaganda advertising carried on by the Hydro benefits the competitor, just as much as it does the Hydro Shop, and in order to make competition fair to all, too great a burden cannot be placed on the Hydro Shop if it is to continue giving efficient service to Hydro customers.

Discussion

Mr. R. C. McCollum, H.E.P.C. of Ont., Toronto: I think Mr. Mickler's idea is in very close line with Mr. Stewart's idea of conducting a Hydro shop, and his idea in regard to the expense is correct. There would not be any harm done if all the costs of advertising were charged to operation. My idea is that there should be no difference in the way of handling the cost of the operation of a shop. If there was more advertising, there would be more general business.



Illumination and Lighting Equipment

By Geo. G. Cousins, Assistant Laboratory Engineer, H. E. P. C. of Ont.

(Paper read before Association of Municipal Electrical Utilities at Toronto, January 29, 1925.)

IN the design of an artificial lighting system at the present time, one of the most perplexing features of the problem is to decide upon the intensity in foot candles that will best serve the requirements of the problem in hand. The trend of practice is toward ever increasing intensities and so far each increase in intensity for a given requirement has justified the extra first cost involved and has proven to be a profitable investment. That is, the work, of whatever kind it may be, has been accomplished in greater quantity and at lower unit cost under the higher intensity than was possible under a previously existing lower intensity. Apparently the saturation stage has not yet been reached where an increase in intensity has not resulted in profitable returns. The engineer is prompted to recommend fairly high intensities, knowing it to be sound engineering practice. The manager or executive seeking advice is apt to balk at the first cost of high intensity illumination. It seems reasonable to assume that the general level of intensities will be increased during succeeding years and in consideration of this it would appear unwise to install a system that would not be equal to what is considered the best at present. It is an unfortunate fact that many dealers and contractors, not conversant with up-to-date information on the subject give most weight to the first cost when dealing with their clients, apparently aiming to secure a contract because of a low estimate. Because of this, many new installations are more or less obsolete when judged by up-to-date standards.

Essentials of Good Lighting

The three primary requisites of good lighting are proper quantity, quality and distribution of light. Quality here referring to the nature of the light as it leaves the luminaire, that is being well diffused so as to avoid harsh shadows and excessively bright reflections from polished surfaces. The distribution of light over the entire room is the most important feature in any system since a moderate amount of light well distributed with the light sources properly located and shaded will produce better conditions for comfortable vision that a greater quantity imperfectly distributed. Although visual acuity is somewhat better under pure white than under unmodified incandescent light, the latter will be found satisfactory for all ordinary purposes. Some industrial and commercial requirements call for daylight quality of light which can be secured by means of proper filters.

Light sources should be placed well away from the normal line of vision and should be of as low brightness as circumstances will permit. The illumination intensity should be sufficient to

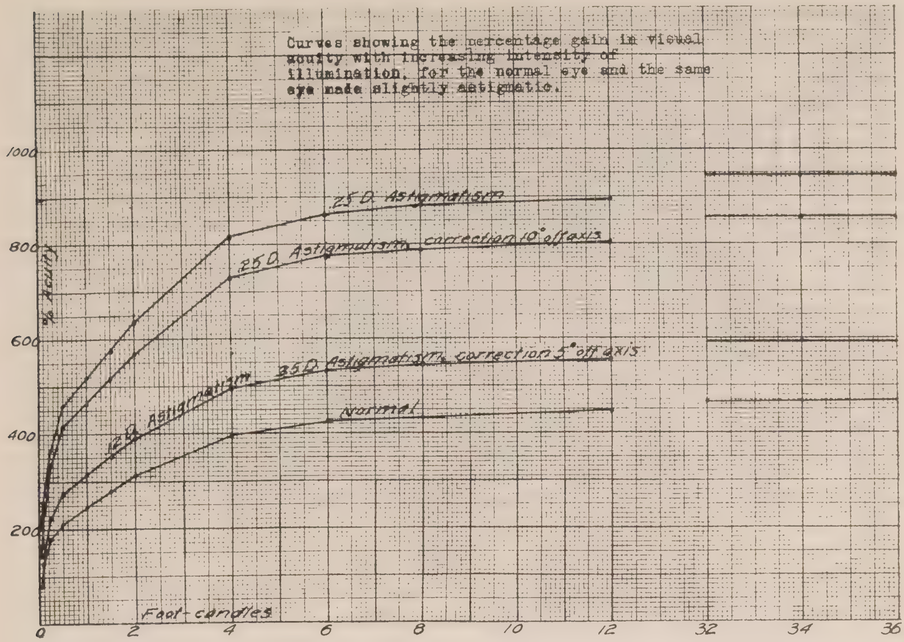

Curves showing the percentage gain in visual acuity with increasing intensity of illumination, for the normal eye and the same eye made slightly astigmatic.
.25 D. Astigmatism
.25 D. Astigmatism, correction 10° off axis
.35 D. Astigmatism, correction 5° off axis
.12 D. Astigmatism
Normal
% Acuity
Foot-candles
1000
800
600
400
200
0
2
4
6
8
10
12
32
34
36

Fig. 1.

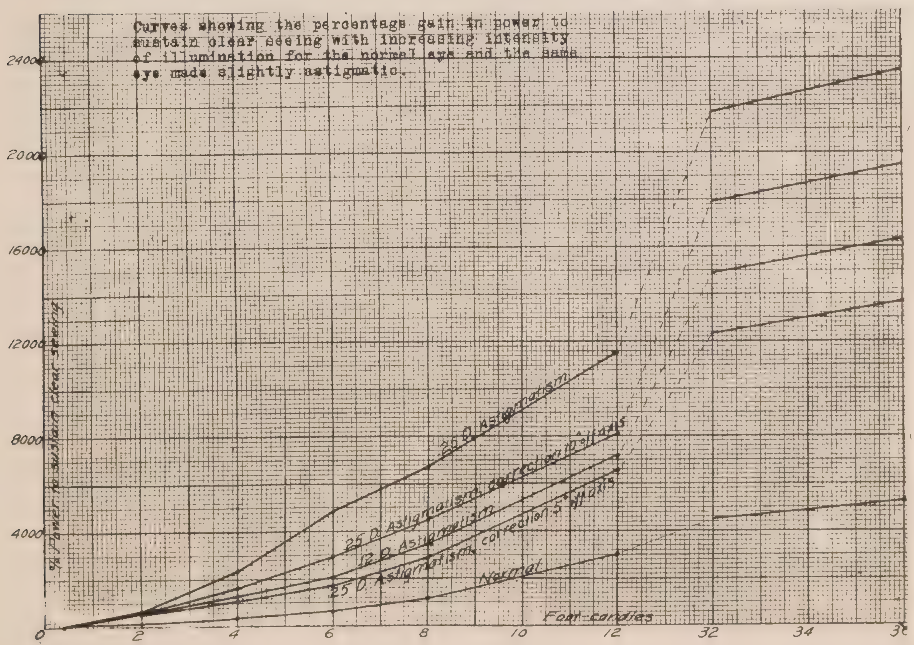

Curves showing the percentage gain in power to sustain clear seeing with increasing intensity of illumination for the normal eye and the same eye made slightly astigmatic.
.25 D. Astigmatism
.25 D. Astigmatism, correction 10° off axis
.12 D. Astigmatism
.25 D. Astigmatism, correction 5° off axis
Normal
% Power to sustain clear seeing
Foot-candles
2400
2000
1600
1200
8000
4000
0
2
4
6
8
10
12
32
34

Fig. 2

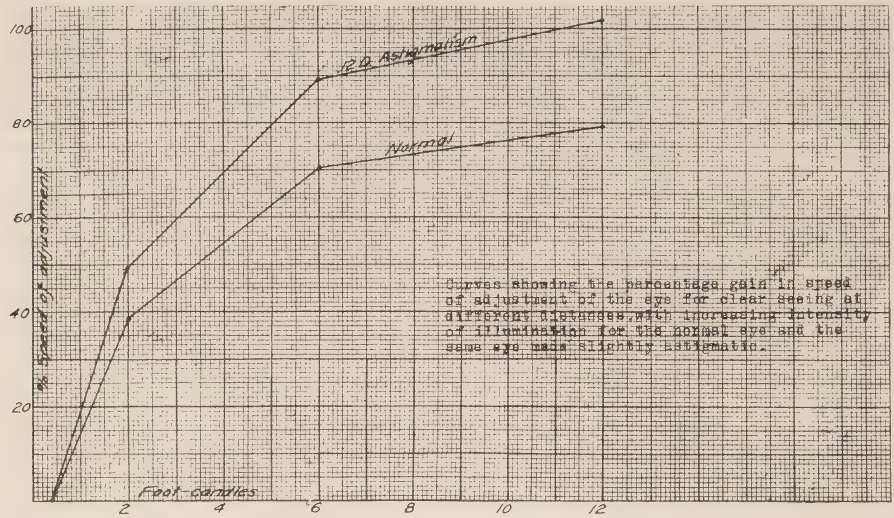


Fig. 3.

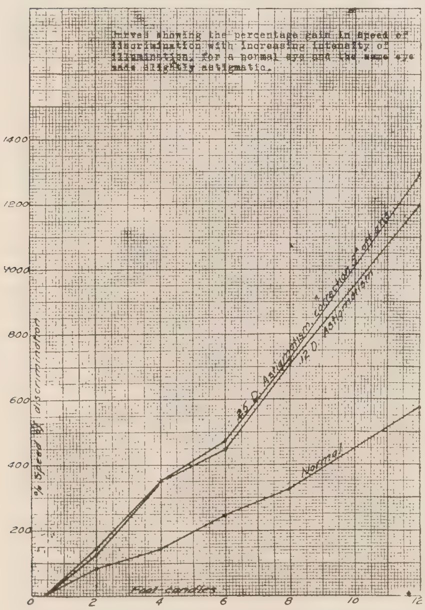


Fig. 4.

allow the eye to recognize the finest details easily and to continue doing this for long periods of time without appreciable fatigue. Light sources should be so placed that plenty of light will fall upon the places where the work is being done, without annoying shadows. Harsh sharply defined shadows are objectionable and should be avoided.

THE FUNCTIONING OF THE EYE.

There are four aspects of vision that are directly affected by the general quality of the illumination. These are acuity, power to sustain acuity, speed of discrimination and speed of adjustment for clear seeing at different distances. It is remarkable to study the effect of increasing intensities on these functions of the eye, provided of course, that the lighting conditions are good so that an increase in intensity does not carry with it an increase in glare. The accompanying curves, figs. 1, 2, 3 and 4 show the increases in the ability of the eye to function properly when the intensity is increased. The curves show the very important fact that defective eyes are benefited more by increasing intensities than normal ones and there are indications that the benefit becomes greater with increasing

age. It is of considerable importance that the greatest gain is shown for the power to sustain acuity which is the function involving time. This means that the eyes become less fatigued as the illumination intensity is increased. It is an easy matter to see large details clearly under comparatively low intensities of light. It is relatively difficult to see small details under the same conditions and the process will probably involve considerable eye strain, but as the intensity is increased the eye will pick out small details more easily and more quickly.

Various investigators have studied these matters in different ways and the results, although obtained by different methods, all substantiate the fact that high intensity illumination produces a large increase in the efficiency of the eye to perform its functions.

Tests on the speed of reading as influenced by intensity of illumination show an increase of 15 per cent for an increase of intensity of from 4-16 foot candles. This applies to black print on white paper. When black print on grey paper was used the increase in the speed of reading was 50 per cent. This latter combination is similar to working on metal surfaces where contrasts are low.

It is not difficult to understand the reasons for these increases in eye efficiency when it is remembered that the eye in examining any surface moves in a series of jerks with intervening intervals of time when it is stationary. It is only during these stationary moments that images are formed upon the retina. It has been shown quite definitely that high intensity allows the formation of clear images on the retina in much less time than that required by relatively low intensity. The higher intensities therefore require a smaller expenditure of nervous energy and the value of this to the individual is quite obvious. Eye strain is caused by the striving to clear up blurred vision by ineffectual maladjustments.

This paper is not intended as a plea for high intensity illumination. However the whole structure of illuminating engineering is based upon such fundamental facts as these and a knowledge of them is essential to an intelligent understanding of lighting principles.

Glare.

The greatest enemy to the illuminating engineer is glare. Glare may be present in one or more of several forms and frequently the most damaging kind is the most elusive and the least suspected. It is human nature to shun a great danger of the sudden-death variety, and to ignore many of the slow-but-sure kind. Our attitude toward glare is somewhat similar. Glare may be caused by excessive brightness, excessive volume or excessive contrast. Probably the most common classification of glare is veiling, dazzle or blinding glare. These terms are self-explanatory and readily understood. Veiling glare is the most insidious and may be present as reflections from a glass or polished top desk or even glazed paper of a bright ceiling and without the knowledge of one suffering from its effects.

Dazzle glare is very common and may be caused by a light source with-

in the field of vision or reflected from a polished surface. Dazzle glare practically ceases when the light source is more than 30 deg. above the line of direct vision.

Blinding glare is the extreme kind and is not often encountered in ordinary artificial lighting systems.

The eye is more sensitive to glare from below than from above the line of direct vision. The angular range of vision is 50 deg. above and 70 deg. below the line of direct vision.

Glare is frequently encountered in ordinary daylight illumination in which case it is very often difficult to control. However with the facilities at our command for controlling artificial light, the glare can be kept within reasonable limits by the judicious selection and location of equipment.

With good diffusing glass, the brightness and consequently the glare decreases as the size of a globe is increased. For instance a 100 watt gas filled lamp in a 14 in. globe would be satisfactory for any reasonable location but when the same is placed in a 6 in. globe it would be about the limit of tolerable brightness even when placed very high. A large globe of given brightness is more glaring than a small one of the same brightness because of the larger amount of light flux emitted by the former.

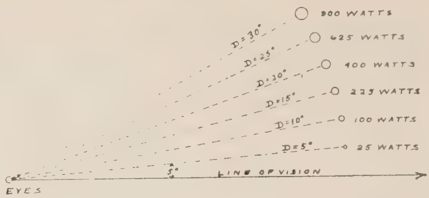


Fig. 5—Showing Effect of Position and Wattage of Light Source for equal amounts of Glare.

The diagram Fig. 5 illustrates the effect of the position of the light source relative to the line of vision for equal amounts of dazzle glare. This emphasizes the importance of keeping even small light sources away from the line of vision. Table 1 gives sizes of globes recommended for the various sizes of gas filled lamps.

Recommended Globe Sizes of High Efficiency, Good Diffusing Glass When Used Unshielded*

Lamp size (watts)	Globe diameter (inches)	Brightness** of brightest square inch (approximate candles per sq. in)
50– 75	8	2.5
75–100	10	2.5
100–150	12	3.0
150–200	14	3.5
200–300	16	4.0
300–500	18	5.0

* The globes are assumed to be substantially uniform in brightness.
** Values that obtain with the larger size of lamps.

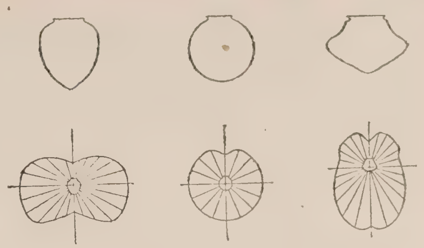
Table 1.

One of the most common and annoying examples of glare in auditoriums is the placing of bracket lamps at each end of a stage or platform. In industry and commerce, reflections from surfaces toward which the eyes are directed are frequent sources of annoyance.

Placing the luminaires high, although a necessary step, is not necessarily the whole solution of the glare problem unless the lighting system is laid out with respect to work spaces, machines, desks, etc., or the reverse, that is the work spaces are arranged so that reflections will be at such angles that they do not seriously interfere with vision. This should be done in such a way as not to conflict with the daylight use of the interior.

Equipment.

Lighting glassware and reflectors are made of various materials which impart different optical properties to the units into which they are made. Because of this some types of equipment are particularly suited to certain requirements. For instance many stores and some offices require fairly high intensities on vertical surfaces. The enclosing diffusing globe is well adapted to this requirement. All diffusing glass of the opal and enamelled types and porcelain enamel are very limited in their abilities to redirect light into given zones. These types of equipment are characterized by their broad distribution of light. The shapes of enclosing globes of white glass have, in general, comparatively little effect on the distribution of light, except when extreme shapes are used, as will be explained later. This applies also to



Control of light by luminaires employing diffusing glass.

Fig. 6.

enamelled glass, white glass reflectors and porcelain enamel. The term globe in the lighting industry is usually applied in a broad sense to a one-piece totally enclosing piece of glass. When the shape departs radically from the older spherical form, a difference in the distribution is produced as illustrated by the exaggerated forms shown on fig. 7. Generally speaking, the proportion of light in any zone produced by a good diffusing globe is proportional to the apparent area of the globe as viewed from that zone. In most enclosing globes approximately one-half of the total light is below the horizontal and one-half above.

The principles of specular reflection and refraction as applied to mirrored glass and prismatic glass reflectors pro-

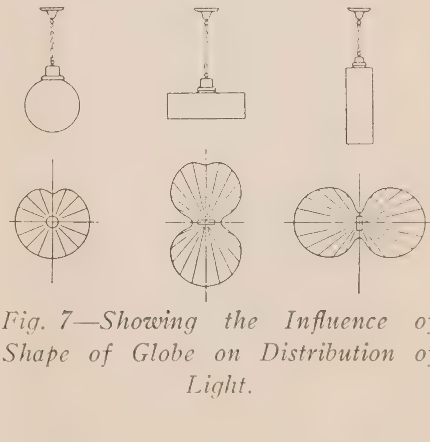


Fig. 7—Showing the Influence of Shape of Globe on Distribution of Light.

duce the most accurate means of light control at our command. Both of these types of reflectors are designed upon scientific principles, each including an extensive line for various forms of light distribution. When accurate control or maximum efficiency are required, one of these types will produce the best results.

Choice of System.

There are three general systems of lighting, namely direct, semi-indirect, and totally indirect, each with its own inherent merits. It has been found that totally indirect lighting produces the least eye fatigue. Indirect lighting is more or less shadowless in effect, which is considered by many objectionable. Indirect lighting is capable of more flexible and beautiful effects than any other system. When applied to office or store lighting, its most suitable form is probably the luminous bowl type which makes use of a translucent bowl to conceal the mirrored reflectors

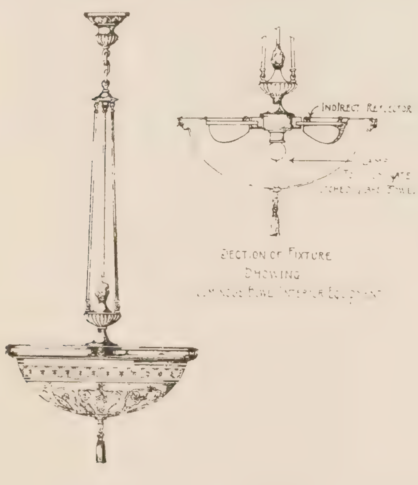


Fig. 8—Bowl Illuminated by an Interior Lamp.

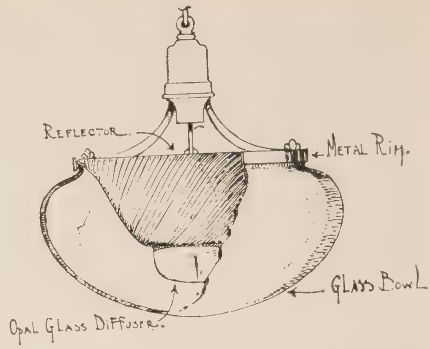


Fig. 9—Bowl Illuminated by Diffusing Cup.

and enough small lamps, one or more, to illuminate the bowl so as to avoid the unpleasant appearance of a dark opaque luminaire against a bright ceiling. (Figs. 8 and 9). It is important to bear in mind that the luminous bowl does not constitute a direct-light component of the luminaire as a whole in the same way that a semi-indirect bowl does. The luminous bowl of the indirect luminaire is usually of tinted art glass and is of low brightness so as not to destroy the valuable eye-efficiency property of indirect lighting. The dense bowl semi-indirect produces a close approach to the same effect as the luminous bowl indirect, but is not so conducive to prolonged eye efficiency although a very dense bowl is a step in that direction. Direct lighting is the most efficient in terms of engineering efficiency and is probably the most suitable where the allowance for lighting is limited. It is the best for most industrial applications. Owing to its nature, it is important to take extra precautions to avoid glare from it. Any conspicuously bright object or light source within the field of view lowers the efficiency of the eyes. The in-

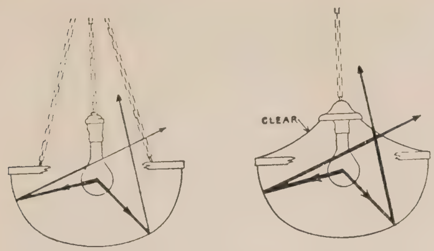


Fig. 10—Showing the Effect of a Glass Cover in Reducing Losses due to Dust.

ference with respect to direct lighting is obvious.

MAINTENANCE.

Maintenance to a lighting system bears the same relation that oil does to machinery. Without proper maintenance a lighting system cannot be expected to operate satisfactorily any more than machinery will operate without oil. The prevailing conditions that would affect maintenance should be taken into consideration in the selection of equipment. Obviously bowls or inverted reflectors suffer the most from accumulations of dust. The reduction in efficiency due to a layer of dust is considerably lessened by the addition of a cover glass over the upper side of the bowl. When this is done the reflecting surfaces are kept relatively free from dust and the light emerging from the luminaire only has to traverse the layer of dust once where it would have to penetrate it twice if the dust were on the reflecting surface itself. This is illustrated in fig. 10. There are several designs of one piece enclosing glass units that have this idea embodied in their designs. These are usually of crystal glass with certain portions enamelled to simulate either the semi-indirect bowl or the two-piece semi-enclosing type in appearance. They are nevertheless dust proof. (Fig. 11.) Fig. 12 shows the relative depreciation of illumination due to dust of several common types of luminaires.

The ventilation of enclosing glass units very often augments the accumulation of dust because of the continuous currents of dust-laden air flowing in at the bottom and out at the top. A large portion of this dust is deposited upon the interior wall of the glass. By closing up the outlet for air, the dust accumulation is decreased but is still much worse than for the unventilated type. Incidentally it may be

Fig. 11—Types of Dust Proof Luminaires.

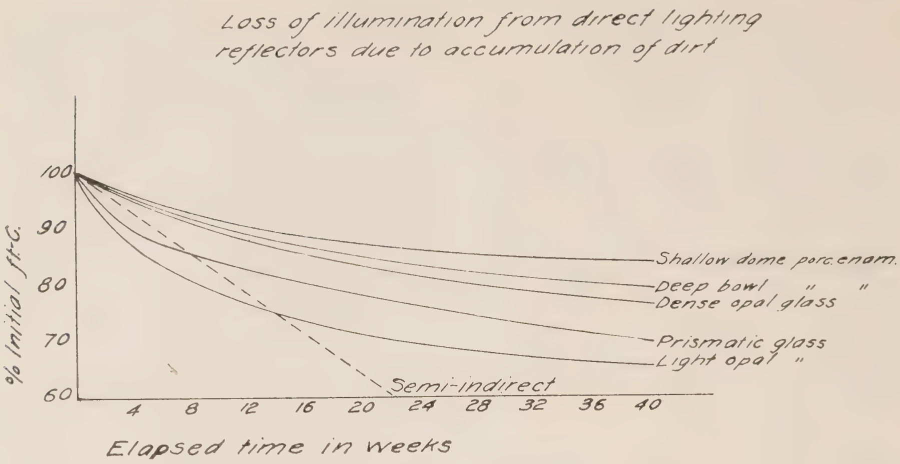


Fig. 12.

stated that the common method of ventilating by having the outlet holes punched in the canopy of the unit often causes a higher temperature in the socket and wiring than would occur in an unventilated unit. Unless the ventilation is such that the outgoing current of heated air is directed away from the socket, the temperature in the socket is increased. In consideration of these features the value of ventilation is open to question.

Some Factors of Design.

In the design of a lighting system the first requisite is to produce illumination for utilitarian purposes generally. Coupled with this is the need for sufficient diffused light to illuminate the interior as a whole so as to avoid any sensation of gloom that a dark ceiling might produce.

In store and office lighting, it is necessary to provide for a pleasing appearance in addition to supplying the purely utilitarian needs. Sound engineering principles should govern the design of any system and ornamentation may be included, but not to the detriment of the utilitarian needs. Very often it is necessary to sacrifice efficiency in order to produce an installation of suitable appearance and in cases of this nature strict efficiency is of secondary importance and the sacrifice is justified. The lighting in such a case really becomes part of the scheme of decoration. The possibilities along this line are practically unlimited.

Each design of a system must make allowance for the color of walls and ceiling, over all efficiency of the luminaire, ratio of room length and width to height, depreciation of luminaires due to dust and ageing of lamps.

For the sake of comparison some figures are presented showing the relative utilization efficiencies of several types of luminaires. These figures show the percentage of total lamp lumens that are effective on a work plane and apply to a room 80 ft. by 20 ft., with

luminaires 8 ft. above the work plane for direct lighting or ceiling height 12 ft. above the work plane for semi-indirect and indirect lighting.

The ceiling is fairly light and the walls fairly dark. The coefficients of utilization values for a number of luminaires are:—

RLM dome	.54
Deep bowl porcelain enamel	.47
Flat cone porcelain enamel	.43
Light density opal glass reflector	.40
Heavy density opal glass reflector	.50
Mirror glass reflector (direct)	.50
Prismatic industrial	.51
Light opal diffusing globe	.28
Flattened top diffusing globe	.34
Two piece opal reflector and enamelled bowl	.35
Dense opal inverted bowl	.22
Mirror indirect	.19
Enamelled metal indirect	.18

Lighting Codes.

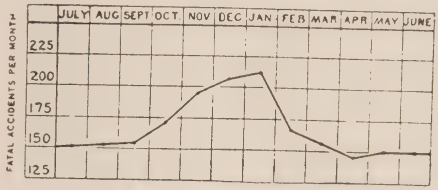
The Illuminating Engineering Society has drafted an industrial and a school lighting code which give information regarding the conditions to be fulfilled to provide reasonably good illumination. The highest values of intensities given should be taken as the minimum required. It has been found that where these codes have been adopted, especially the industrial code, a notable raising of the levels of illumination has resulted. These codes are prepared principally for the protection and welfare of the workers and scholars. In the case of school children, it is necessary to safeguard their eyesight so that they will not approach maturity, when they must make their own way, with such a handicap as subnormal vision.

The lack of proper lighting has resulted in a large proportion of industrial accidents and one of the objects of the industrial lighting code is reduction of the number of accidents, which cause much human suffering and cost enormous sums of money annually. There is a striking similarity between the curve of accidents plotted month by month and the hours of darkness per day as shown by fig. 13, which is a strong indication of the relation between the two.

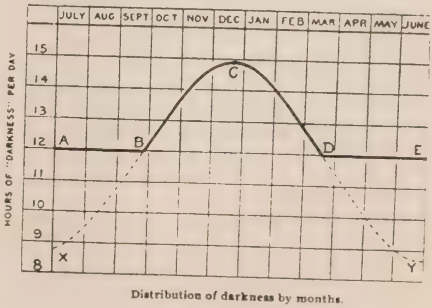
Insurance companies are demanding higher rates for factories that have not complied with the requirements of the lighting codes and there is now an attempt being made to have credits issued in the form of reduced rates for factories whose lighting is up to a certain standard.

Conclusion.

During very recent years attempts have been made to place a definite valua-



Showing relation of daylight to accidents



Distribution of darkness by months.

Fig. 13.

tion upon good lighting in terms of results obtained. Information of this sort, although very difficult to secure, has presented quite definite proofs of considerable net gains by the use of high intensities. The unit cost of production in industry has been lowered and much valuable material saved due to decreased spoilage. Retail merchants have found that sales can be considerably stimulated by the expedient of raising the lighting intensity of a certain section of a store above that of its surroundings.

The lighting of offices in conjested business districts during the day has always been a troublesome problem. It is now possible to provide artificial illumination that is more uniform in its distribution and more reliable than daylight when a limited area of sky is exposed to the windows.

In factories, offices and stores, a great many people are working continually during the day under artificial illumination only. In order to get a fair return from these employees a high grade of lighting is necessary.

It has been stated that the street lighting of Hydro towns and cities is noticeably better than in non-Hydro districts in Ontario and the United States, but that the difference regarding interior lighting is reversed with respect to American towns. The lighting of Hydro streets is planned by engineers but it cannot be said that interior lighting has a proportionate amount of engineering expended upon its design. Lower power rates provide us with a valuable weapon in a campaign for good interior lighting.

Education regarding the benefits of good lighting must pave the way for a general improvement.

Discussion

Mr. E. V. Buchanan, London: Mr. President, I have enjoyed Mr. Cousins' paper very greatly. Ilumination seems to be extremely technical. It is very difficult to set the idea before the average manufacturer. I know we have found it to be so.

An example was seen, when the new High School in London was being built. I thought that we ought to try and give the School Board some advice on the subject of lighting, and we had Mr. Cousins come up to London and look over the plant and suggest different schemes of lighting for the various class rooms. We made the mistake, however, of putting our recommendations in the form of a tender for the job. We not only suggested the kind of illumination but we put the price for which the fixtures could be obtained; and when the School Board received the tender, and tenders from other people, they simply decided the matter on price. No specifications, as a matter of fact, were submitted by the Board of Education. It was simply that they wanted to light the school. "Give us your price".

Although there was very little difference between the price which we gave them for the suggested system and the

price of the successful tenderer, there was a vast difference in the quality of illumination.

Another example that we had was in a store which we equipped. We just had it installed and the store opened up, and the storekeeper called me up one morning very much excited. He said he had been just about to close up his store the night before,—in fact he was working late,—when a chap came in with a big black box and pulled out a lamp. He said he was sorry to see that the storekeeper had had his illumination put in. He took down one of the globes and put up his lamp and said "Look at it", and that he could give it at about half the cost of what we had installed. Of course the storekeeper did not ask what the wattage was, but he thought it was a very fine light. I asked the storekeeper "What was it that attracted you?" He said it was a mighty fine light. I said, "You do not want your customers to look at the light but to look at your goods. Now let us walk around your store and see if the lights light up your goods." After that test he was satisfied that he has one of the best jobs possible.

The public do not know much about the technical points. If you show them a nice piece of glassware, that is about all they consider.

Street lighting is a different matter. We have a free hand, and we put up practically what we like, and we get better results.

The matter of house lighting has always been a great problem, because there are so many factors which enter into it. You know that the average living room is very poorly lighted. The women do not like brightness. I do not know what they are afraid of, whether it is their complexions or something of that sort; but you find that the average living room is very dismal. I think possibly it is an attempt to get absence of glare. I think it is possible to get absence of glare, to get proper distribution and get an absence of gloom and, what is possibly the most essential in house-lighting, to get a pleasing effect.

I have done so much experimenting in my own living room that my wife threatens to throw me out on the street if I bring home any more devices.

Mr. Cousins: Mr. Buchanan has said something about which I meant to have said a little bit. In home lighting you want light with comfort and coziness. The best way I know of in which to do that is to have indirect lighting, and then accentuate it with your portable lamps and your table lamps, so that you can easily flood the room with light for social purposes. I think that will give you greater comfort and pleasure than can be obtained in any other way. Get enough soft, diffused light so that the room does not appear dark and gloomy, when you look away from the portable lamp.

Practical Illumination

By I. B. Smith, Illumination Engineer, Toronto Hydro-Electric System

(*Paper read before Association of Municipal Electrical Utilities at Toronto, January 29, 1925.*)

I HAVE been asked to tell you in a few words of what the Toronto Hydro are doing to co-operate with our customers and create good will.

We are all familiar with lighting developments of the past few years, and we are indebted to the Illuminating Engineering Society, the Lamp Manufacturers, The National Electric Light Association, the Society for Electrical Development, the Electric Service League and others, for gathering and disseminating this knowledge.

A large number of Central Stations have added or are adding lighting Departments to their organizations. Sometimes this Department is composed of one man who is competent to handle any problem of illumination which he may encounter or in the case of large Cities or large territories several men may be employed, each specializing in one or more branches of illumination.

These Departments have already accomplished a great deal, co-operating with Architects, Consulting Engineers, Electrical Contractors, Fixture Dealers and Building Owners in the laying out of new installations and the remodelling of old installations to conform to present day standards.

This work has only been started, however, and it should be the aim of such Departments to assist Owners and Architects in every possible direction. The type of architecture and use to which the building is to be put should be considered in laying out the wiring, so that the system of illumination and fixtures will harmonize with architectural details and be in keeping with the purpose of the building.

It is highly advisable to consider future needs in making plans for the lighting requirements of a building and to make recommendations which will allow of additions and changes being made without prohibitive expense.

The illumination of Churches is constantly receiving more attention and is appreciated as a factor of importance in Church services. Their possibilities are being utilized and many obsolete installations are being remodelled.

The different branches of retail merchants are beginning to see the advantages of proper illumination as a business getter and are using the Lighting Service Departments of the Central Stations to recommend installations to show off their merchandise to every advantage. One Central station in the States last year drew plans that led to the

installation of over 3,500 jobs. As a rule where a Manufacturer or Storekeeper or anyone else buys Lighting he really does not know what he is going to get. He goes out and buys wire, lamps, reflectors, current from the Central Station and has a Contractor put them all together and he does not know what the result is going to be until the work has been done, the current turned on, and in a good many places his bills paid, in other words he is buying something in a bag. He does not know what it is going to look like. That is different from the basis on which he purchases practically every other commodity. Let us take a simple case, the purchase of a hat, if you like. He goes out to buy a hat, he puts the hat on his head and gets a glance at it in the mirror. He balances the appearance of that hat and the texture against the cost in dollars. Before he buys it, he sees it. He does not have to visualize it or guess at what it is going to look like, but the condition is entirely different when buying his lighting. Unfortunately he has to buy lamps from one part, reflectors from another, wire from a third, kilowatt hours from the Central Station and he has to trust to luck to get the proper result.

Every Central Station should be equipped to help its customers with their lighting problems.

Most Manufacturers, for instance, when approached on the subject, really believe that their lighting is excellent. They may think that it is, but who is there to tell them that it is not? They may have high wattage lamps burning without getting the full value out of them because of improper spacing or improper reflectors, etc. If they have the wrong type of reflectors, the lamp can cause a glare which is ruinous to a man's eyesight and then the man's ability has decreased and not only that, but poor light can cause accidents and then a new man has to be trained to do the work.

I was talking to a Manufacturer at the recent Illuminating Engineering Convention, and he was telling me that his factory was working overtime but could not keep his production up to supply demand. He couldn't take on more help as he hadn't the room. Every available space was being utilized till someone happened to ask him about his lighting. At the time he had an intensity of about 8 foot candles. He was persuaded to raise that intensity up to 15 or 20 ft. candles, which he did, and he increased his production by over 15 percent. which only goes to show what lighting will do. Take another example in the way of a retail store. I suppose everyone has seen Arnold's new stores. The one in Parkdale for instance is situated on the wrong side of the street but its illumination, which happens to be a treat for sore eyes, has literally taken the crowd away from the other side of the street, so much in fact, that almost any time of the day you can find a big crowd of cars parked all around there and Saturdays a policeman is usually

on hand to direct the traffic.

Customers want to see things clearly and distinctly and light is the only thing that will show merchandise off to its best advantage, and that is where the Central Station comes in to properly indicate to the Merchant what he needs in the way of lighting and how to get it.

With this end in view, the Toronto Hydro is equipping a lighting demonstration room for the purpose of giving service to its many customers. It is being equipped to actually show the customers, Contractor Dealers or any one who is really interested, what proper lighting means.

When I say what the Toronto Hydro-Electric System are doing, I mean that they are actually going to try to get in touch with customers who are in need of better lighting. It may be in the way of direct-by-mail advertising or newspaper advertising or other means of getting in touch with customers and advising them of this free service.

The room will be equipped to show the earliest types of electrical illumination. It will show how the carbon and then the tungsten lamp was first used to light factories and will work up to the gas filled lamps hanging down bare without reflectors, causing a bad glare and from there will show what improper spacing of even up-to-date reflectors will do in causing shadows and an uneven distribution of light. This will be followed by a demonstration of proper installation of a lighting system, showing off its advantages in every way.

The room will also be equipped to show the new Glassteel diffuser type of reflector for use in industrial plants where highly polished materials are being worked with, and then the enclosing glass units for commercial or office use and also the totally indirect lighting system where the best of diffused lighting is wanted.

In other words the Toronto Hydro are going to try and show their customers what kind of lighting is best adapted to their particular class of work. All of this information is supplied to Hydro customers free of charge as a part of Hydro service.

If any one is interested in any way and would care to see the Lighting Service Department and Demonstration room during this Convention, or at any other time, a visit can easily be arranged at his convenience.

Discussion

Mr. G. J. Mickler, H.E.P.C. of Ont.: Mr. President, in asking Mr. Smith to present the paper which he has just given us, I had in mind drawing to the attention of the delegates present what the Toronto Hydro has started to do, in the hope that other municipalities would emulate their example, in

at least attempting to open an industrial lighting department, to assist industrial consumers, industrial establishments and stores in establishing proper lighting. I think it is an excellent one.

Servicing Electrical Appliances

By C. J. Burton, Appliance Chief,
Detroit Edison Company, Detroit, Mich.

(Extracts from an address before Association of Municipal Electrical Utilities, at Toronto, January 29, 1925.)

I PROMISED Mr. Mickler that I would come over here and tell you about our appliance repair service, and what we are doing in Detroit to keep electrical appliances at work.

Good service is the best advertising an electric light company can have. To give good service, we must go beyond our contract obligation so far as to see to it that a customer's apparatus does really function properly.

It may be that there will come a time when the use of electricity will be to everybody so much a matter of course that an electric light company need do no more than deliver its current to the customer's premises. We are much nearer this goal than we were twenty years ago, and the radio recently has served marvellously to put the younger generation on speaking terms with electricity. But we are still in the era where electricity is a mystery to the man in the street, and the ordinary customer expects to be helped,—in fact needs help,—in the use and adaptation of it to his needs. The Electric Light Company is the medium through which this help should reach him. We all want our service to be used to the limit. Whether we want to serve all of our public or not, it is our business to do so.

Our business is justifiably monopolistic. The countervailing obligation is that we serve the public so far as we are able, and serve the public well, and see that each customer shall receive for his payment to the company the best possible value in service.

As for the household appliances, here we cannot hope that more than a very few will have mechanical ingenuity to keep electrical appliances in repair. I have known an electrical engineer who could not fix the household flat iron when it was out of commission. What can we expect of a lawyer or a grocery clerk? Yet we want everyone of our resident customers to use as many appliances as possible and use them regularly to improve our load factor and to increase our revenues.

When a flat iron goes out of business in the midst of the Tuesday iron-

ing, a woman, whose week's work schedule is disarranged thereby, does not stop to consider whether the blame should be laid at the door of the Electric Light Company, the manufacturer of the iron, or her own misuse of the iron; but if the Electric Light Company has a repair man at her house within the hour to put the iron in working condition or loan her another one, she is very sure to give full credit to the Electric Light Company and tell her neighbours about it.

A company can keep in repair many thousands of flat iron cords for $25,000 a year. Customers having the advantage of this free service value it far beyond its cost to the company. Many companies have liberal advertising appropriations. A $25,000 addition to the advertising appropriation of any of these companies would have a relatively small effect, but if spent in keeping domestic appliances in order it is the best kind of direct advertising. Isn't it the best kind of advertising to have your customers feel that they can depend on you in emergencies that arise in their service?

All the customers are human beings like ourselves, who are buying something from us and paying for it, and who, as individuals, are going to size us up according to what they get for the money we take. These customers know the value of the service to them, and when a large number of them recognize that they are getting good value, there grows up in the community that feeling for a Public Service Corporation which is the most vital factor in its continuing existence, that is to say, favourable public sentiment. (Followed here, statistics not published at the request of The Author.)

Mr. Mickler has asked me to answer the following questions:—

The first question is: How do we live up to the manufacturers' guarantee, how take care of service calls and the expense thereof during guarantee period?

The manufacturers' guarantee is almost uniformly one year from date of purchase. During this period all defective material is replaced to the customer without charge. We, in turn, send in such defective material to the manufacturer for replacement to us.

The second questions is: To what extent is free servicing carried on and what benefits are derived to offset the cost of this free service?

We do not make any charge to our customers for servicing appliances except for material required, which is furnished at approximately our cost. We feel that there is sufficient benefit derived from our keeping these appliances in continuous use and in increasing and holding the goodwill of our customers.

The third question is: How is the cost of operating the service department charged in the operating expenses of our Company, and is any allowance made for the fact that keeping appliances in operation benefits the power department through increased consumption?

We have an operating account against which we charge the cost of our free service to electrical appliances, which by the way amounts to about $150,000 a year with our company. This amount is absorbed partly by the profits on appliance sales and

the balance is charged up against advertising.

I thank you, gentlemen, for your kind attention; and if there are any questions you desire to ask, I shall be glad to answer them.

Discussion

Mr. G. J. Mickler: Mr. President and gentlemen: The question of Servicing Electrical Appliances is engaging the attention of a good many utility managers at the present time; and it is one of the most important features in the successful operation of utilities; nevertheless sad to relate this service is being greatly neglected in most Hydro towns, at least the importance of keeping the electrical appliances in operation is not appreciated.

In asking Mr. Burton, of the Detroit Edison Company, to speak to us today, I felt that it was a subject that was well worth presentation to us, in order that we may see how a large private corporation views the question of appliance servicing.

Mr. E. V. Buchanan, London: I am very much interested in Mr. Burton's paper, and I quite agree with what he says about the advantages of servicing electrical appliances. I think it is very important indeed. The fact that a private company puts so much emphasis on it justifies the existence of our Hydro Shops, which are sometimes criticised. A private company runs their appliance department because they think it is good business. Why should not we? It is an established practice. It goes hand in hand with our business.

The number of appliances that were serviced in Detroit is quite startling. I might say that the number of similar trouble calls answered in London was about the same ratio to the population.

I do not at all agree with Mr. Burton, however, in the matter of free servicing. I think the principle is absolutely wrong. If you render a service to a customer and charge a reasonable price, the customer will be just as well satisfied as if he received that service free. There would be no difference, in my mind, whether you could do it free or not, and in fact I think the customer will appreciate it more if he pays for it.

As I say, the principle is wrong; because why should I have to pay on my electric light bill for the man or woman who misuses the electrical appliances in his or her home? That is what it really amounts to.

As a matter of fact, we have been getting away from all free service. In the old days, you know, we used to renew lamps free. I see my friend who used to run the old Electric Light Company of London smile. He thought he was going to put one over us when we stopped it, and he was giving it. Then we used to give new fuses free; and when the appliances came along, there was a tendency to do that too; but I think there is no claim where the appliance guarantee has expired and there is no blame on the manufacturer; the cost of the service should be charged for. We have no complaint

because we do it in that way, and everyone pays his fair share; but I do think that you ought to give fair attention to the public. The more you give the more they want. You would have to be equipped like a fire station in order to give the service which the public wants.

When a washing machine goes out of order, you will have three calls in an hour. You will be told that the man hasn't come yet. When is he coming? Of course if a woman is stopped in the midst of her weekly washing it is a most annoying thing to her. We try to give service.

Mr. Burton: I do not know how to answer except to say that we are firmly convinced that our policy is right. First, we are equipped like a fire station. We have men on duty 24 hours a day, and we feel amply repaid if our customers will call us up and say that they want to use some electrical device. We have current for sale and we want them to use it. Often a customer will call upon us and say that his lights are off; and we go out and find that the fuse has blown, and it is due to some device which the customer has attempted to use, some trouble which we can rectify in just a minute's time. We do not make any charge for renewing a fuse at any time. We are glad to render a service which takes but a few minutes' time.

Our Company furnishes free an installation of Mazda lamps to our resident customers, and we furnish them free renewals on these lamps when they burn out; and that is all taken into consideration when making the rates. We cannot give them away, you understand, but it is all a matter of the rate; and the service we give is covered by the rates.

I am glad to work for a company over there which has the goodwill of its customers and which is a prosperous going concern.

Mr. Buchanan: I do not want to take up too much time, but perhaps our difference of opinion is due to a difference of policy. Hydro policy is service at cost, and it does not matter what the service may be; it is service at cost, whether power cost or cost of appliances.

Mr. H. O. Fisk, Peterborough: Mr. Chairman, may I ask through you what is the price of juice in Detroit?

Mr. Burton: We do not have any flat rate. The residence rate is based on the number of rooms in a house. A customer will be charged twelve cents a unit for three units in a room. In the average residence he pays 12 cents a unit for 9 units, and all the follow on units are at 4 cents. The average lighting cost of a house in Detroit is \$2.90. As compared with steam generated current, we have a low rate. In that connection I may say we have quite a large range demand. We have about 6,000 ranges in service, and the average residence bill for all the lighting and other current, including the range, is about \$6.50 a month; that is including the range and all other appliances in the house. It is all right on the same meter with the residence lighting.

Mr. J. G. Jackson, Chatham: Mr. Chairman, I think the question of free service is one which deserves a great deal of consideration. Mr. Burton's paper gives us a suggestion which might be useful in some municipalities,

to feel that they could furnish this service without any additional expense.

In view of the fact that three shifts of operators are necessary in sub-stations, very often it is difficult for the man in charge of the operation of a sub-station to keep these men busy; very often they are not usefully employed; and we have found that when the outside trouble man encounters any cords, toasters, or even a range which can be moved, he can bring them into the sub-station and the sub-station operator will perhaps repair them during a shift when he is not busy; and the man whose duty it is to attend to a customer's service can fix them up. In that way the labor charge is very light.

Mr. F. T. Stocking, H.E.P.C. of Ont.: I would like to ask if there is any special rate for ranges in Detroit?

Mr. Burton: No, sir, the ranges are connected directly with the residence lighting meter, and the range service all comes on the follow on rate at 4 cents, and with the 12 and 4 cent rate it comes on the bill. Cooking alone would be about $4.12 a month, and the lighting and so on about bring the bill up to something over $6.

The gentleman from London suggested a reason for charging for this service. I think you might be surprised if you went out and took a survey in your particular town and found the number of appliances which are up on the shelf and not being used, because the customer hesitates to call you up and tell you that he has something which has to be repaired, because he does not know whether it is going to cost 50 cents or $5 to have the repair made. The appliances on the shelf do not help the Electric Light Company at all.

Mr. E. R. Lawler, H.E.P.C. of Ont.: I would like to ask Mr. Burton if the free service is carried on with the rural customers, on the rural line, whether they give free service there also.

Mr. Burton: Yes, our service is uniform, everywhere. We only have one rate; everyone on our line has the uniform rate and the uniform service.

Mr. Mickler: I would like to ask Mr. Burton what proportion of the cost of the free service is borne by the Power Department.

Mr. Burton: There is no fixed percentage. We expect the profit on the sales of appliances to absorb part of the cost of the free service, and part of it to be charged up to advertising. Now that is a beautiful theory, but as to how it gets down in actual dollars and cents, I cannot say. At the present time one hand is washing the other.

Mr. A. W. J. Stewart, Toronto: Mr. Chairman, as to the point brought out by Mr. Buchanan about a customer whose washing machine breaks down in the middle of a washing, in Toronto we have a rule that such a case is to be treated as an emergency job. The repair department can go to the sales room, and a salesman will leave the floor and go out and fix the machine, if possible. It may be an intricate job which he cannot do; or it might be a broken valve and he can fix it up and get the machine working again and the customer satisfied; and we feel that is more satisfactory than to have the salesman on the floor trying to sell another washing machine.

Mr. G. W. Blay, London: We also give calls for washing machine repairs a preference, and the electric stove calls are also considered as emergencies. We certainly would like to have one of those $150,000 expense accounts; but, like Mr. Burton and Mr. Buchanan, I am convinced our policy is right!

Aerial Lead Covered Cable Distribution

By C. E. Schwenger, Distribution Engineer, Toronto Hydro-Electric System

(Discussion before Association of Municipal Electrical Utilities at Toronto, January 29, 1925.)

MR. STARR has requested me to open this discussion for him. In Orillia he has constructed about one-half mile of lead covered papered insulated 22000 volt 3 core cable on overhead aerial messenger and is operating it at 22000 volts. The choice of aerial construction was made as it was necessary to get a duplicate supply to one of his Stations over a route differing from that of the existing supply. The new route was through a district having a great many trees. On account of the location of the transformer station to be supplied not being a permanent one regular underground construction was not considered. In a case like this the use of aerial lead covered cable is ideal. This cable has been in service about six months and is carrying about 2400 h.p. (I am not familiar with construction details, that is messenger size, type of hangers, etc. This can be answered by Mr. Starr.)

As it was my intention to enter this discussion I shall just continue from this point and draw attention to conditions in Toronto. For the past 12 or 13 years aerial lead covered cables have been used by the Toronto Hydro. One of our Stations was supplied by a No. 4, 3 core 13,200 volt paper insulated lead covered cable strung on ½ in. stranded galvanized steel messenger. Ordinary marlin hooks were used similar to those formerly used by the Telephone Companies. This cable was in service for about 5 years, 1912 to 1917. In 1917 the load and Sub-Station supply became of sufficient importance to go to regular underground construction.

The aerial cable was taken down from the poles and reinstalled in the new duct system and is still in service. During the 5 years that this cable was in service overhead on a messenger, no trouble whatever was experienced with it. The cost of messenger, guying, and supporting of cable in this case was equivalent to the proportion-

ate cost of one duct in an ordinary 12 or 15 duct line. The use, therefore, of the aerial cable forestalled the installation of the regular underground duct line for 5 years and thereby saved the System the carrying charges on the costly duct system during a period when it would otherwise have been used very little.

During the past year further installations of 13,200 volt aerial cables have been made on the Toronto System. Three cables 250 M. cir. mils., 13,200 volt paper insulated, lead covered, have been strung in the East end to supply the new Danforth Automatic Station. Very permanent construction is used. The messenger consists of ⅝ in. stranded copper clad or what is sometimes called copper weld stranded. Copper weld cable clips were used. All guying of poles supporting this cable is with ⅜ in. copper clad steel stranded guy wire. The cable sheath contains 1 percent. antimony. At each joint in the cable the messenger is fire-proofed with 1 in. asbestos board. This is necessary should a joint blow out the resulting arc might otherwise open the messenger and allow the cable to drop to the ground. These cables form parts of three circuits, one of these circuits is 16,500 ft. long and the two others are 12,500 ft. long each.

The cost of supporting on the messenger, including copper and supporting material, as well as the necessary guying amounted to approximately 60¢ per ft. This compares very favorably with the proportionate cost of one duct in ordinary duct line of reasonable size. Thus by supporting the cable in this fashion we obviate the necessity for several years of making an underground duct system which in the case in hand would have meant an additional expenditure of about $7.00 to $8.00 per ft.

Since about 1912, several No. 6, 3 core 2,400 volt paper insulated lead covered cables have been in service. They are strung on ⅜ in. strand steel messenger on our concrete poles. They operated up to about 1918 at 2,400 volts, and since then at 4,150 volts. During this time no trouble whatever has been experienced. This construction is very useful where we have heavy foliage to encounter and the regular open wire construction for primaries is difficult, it is also useful where a primary line has to be strung in a section where only our short concrete poles are installed. The expense of installing the aerial lead covered cable is a very small fraction of what it would cost to substitute the high cedar poles for the concrete poles.

During the past three years installations have been made on the System of rubber insulated bronze braided armoured cable. This is of an experimental nature. The use of a No. 7 cadmium bronze conductor has been tried covered by ¼ in. of 40 percent. Para rubber. This rubber is covered by two layers of rubberized tape, the whole being closely braided over with No. 28 bronze braided armour. The use of the cadmium was with the idea of making the cable self-supporting thus obviating the necessity for a supporting messenger wire. It has been found, as far as we have gone, that a cable of this type is not likely to work out as a self-supporting conductor. A later construction, and we have several installations, is to use ¼ in. copper

clad or copper weld steel messenger for the support of the cable of the foregoing specifications except the conductor is No. 8 copper instead of No. 7 cadmium bronze. This cable is attached to the messenger by copper clad or copper weld hooks. This conductor is used on single phase installations on the 4,000 volt system. The copper conductor is the phase wire and the bronze braid in the neutral is grounded every 200 feet and is also tied in to the common neutral of the system. So far very little trouble has been experienced with these experimental installations. Those troubles which have taken place we have directly traced to faulty installations.

List of Electrical Material, Devices and Fittings

Approved by The Hydro-Electric Power Commission of Ontario in February 1925.

Appliances

CANADIAN WESTINGHOUSE COMPANY, LIMITED, Hamilton, Ont.

"Westinghouse" Industrial Air Heaters, Style Nos. H.19452, H.19454, H.20057.

* * *

CLEAR VISION PUMP CO. LTD., 510 King St., E., Toronto.

Electric-lighted Gasolene Pumps, "Clear Vision Pump Co. Ltd."

* * *

THE FITZGERALD MANUFACTURING CO., Torrington, Conn.

Electric Fans "Star Rite".

* * *

NATIONAL REFINING COMPANY, LIMITED, 34 Ross St., Toronto, Ont.

Electrically-operated Dental Engine and Lathe.

* * *

RUSSELL ELECTRIC COMPANY, 340 West Huron St., Chicago, Ill.

"Hold-Heeter" portable electric Air Heater.

* * *

SEPCO AUTOMATIC ELECTRIC HEATERS LIMITED, 39 Richmond St., E., Toronto.

"Sepco" Electric Water Heaters.

Automatic types D3020, D3030, D3045, D3010 and D3015.

Non-automatic types D3320, D3330, D3145, D960, D975, D910 and D915.

* * *

THE UNITED ELECTRIC COMPANY OF CANADA, LTD., 14 Breadalbane St., Toronto.

Motor-operated Floor Polishing Machine, "Ohio".

* * *

THE FRANK E. WOLCOTT MANUFACTURING COMPANY, Hartford, Conn.

"Torrid" Electric Soldering Iron.

* * *

WILMOT CASTLE COMPANY, Rochester, N.Y.

Electric Water, Dressing and Instrument Sterilizers, "Castle".

* * *

*AMERICAN FLYER MFG. CO., 2219-39 S. Halsted St., Chicago, Ill.

Toy Transformers (as listed on Underwriters' Laboratories card, dated Jan. 9, 1925).

* * *

*KILLARK ELECTRIC MFG. CO., 3940 Easton Ave., St. Louis, Mo.

Transformers - Bell - ringing. "Killark". (As listed on Underwriters' Laboratories card, dated August 8, 1924.)

* * *

*BURDICK CABINET CO., Milton, Wis.

Portable Therapeutic Appliances. (As listed on Underwriters' Laboratories card, dated Dec. 23, 1924.)

* * *

*EXCEL ELECTRIC CO., THE, 20th and Walnut Sts., Muncie, Ind.

Fireless Cooker.

* * *

*MANNING BOWMAN & CO., Meriden, Conn.

Cooking and Liquid Heating Appliances.

Disc Stoves.

Percolators.

Tea Ball Tea Pot.

Toasters.

Table Stoves.

Waffle Irons.

(As listed on Underwriters' Laboratories card, dated Jan. 20, 1925).

* * *

*METAL WATE CORPORATION, Two Rivers, Wis.

Toy Range, Cat. No. B.26.

Toy Engines, Cat. Nos. B.30, B31.

* * *

*POST ELECTRIC CO., 30 East 42nd St., New York, N.Y.

"Metalectric" soldering iron, "Electro-Singe", and "Stylelectric Pen".

* * *

*ROBESON-ROCHESTER CORP., 176 Anderson Ave., Rochester, N.Y.

Electric Percolators. (As listed on Underwriters' Laboratories card, dated December 23, 1924.)

* * *

*WISCONSIN ELECTRIC CO., INC., Racine, Wis.

"Dumore." Type D2. Portable fractional h.p. motor, 115 volts a.c. or d.c. 175 watts.

* * *

Fixtures

VENETIAN ART CO., 728 Richmond St., London, Ont.

Portable Electric Lamps. "Venetian Art Co. Mfgrs., 110 V., 40 W."

* * *

A. JENSEN, 11 Doulton Ave., London, Ont.

Portable Electric Lamps. "Jensen, London."

* * *

THE FRENCH IVORY PRODUCTS LIMITED, 1475 Queen St., W., Toronto.

Portable Electric Lamps, "Ivoris".

* * *

NU-ART LIMITED, 7 Hunter St., E., Peterborough, Ont.

Portable Electric Lamps. "Nu-Art Limited".

* * *

NATIONAL PICTURE FRAME & ART CO., LTD., 92 Adelaide St., E., Toronto.

Portable Electric Lamps. "National Picture Frame & Art Co.".

* * *

IMPERIAL RATTAN CO. LIMITED, Stratford, Ont.

Portable Electric Lamps. "Imperial Rattan Co., Limited, Stratford".

* * *

THE CROWN ELECTRICAL MFG. CO., LIMITED, Brantford, Ont.

Portable Electric Lamp, "Adjustolite".

* * *

G. L. IRISH, 499 Queen St., W., Toronto.

Portable Electric Lamps, "G.L.I.".

* * *

ALFRED P. CORKING, 538 King St., E., Toronto.

Portable Electric Lamps, "A.P.C.".

* * *

THE A. DELRUE PHONOGRAPH CO., 184 Wallace Ave., Toronto.

Portable Electric Lamps, "A. Delrue & Co.".

* * *

Switches

*LANGLEY ELECTRIC MFG. CO., 677-79 Notre Dame Ave., Winnipeg, Man.

Panelboards. "F. A. Triumph". Types TC, TP, MR, NR. "Safety", Types, TCD, TPD.

* * *

*HUBBELL, HARVEY, INC., Bridgeport, Conn.

Flush Switches.

Surface Switches.

(As listed on Underwriters' Laboratories cards, dated June 20, 1924, and February 6, 1925.)

* * *

MESSERVEY'S INDUSTRIES INC., 257 Washington St., Buffalo, N.Y.

Current Taps. Two light. Cat. No. 100; Three light, Cat. No. 200. "Buffalo".

* * *

NORTHERN ELECTRIC CO., 121 Shearer St., Montreal, Que.

"N" Split Knob. No. 5½.

* * *

*KILLARK ELECTRIC MFG. CO., 3940 Easton Ave., St. Louis, Mo.

Conduit Boxes. "Electrolet." Types, C.E., LB, LL and LR.

* * *

*These devices are under the Underwriters' Laboratories re-examination or label service.

Re. Municipal Populations

To enable The Bulletin to give as nearly as possible the correct populations of the Hydro Municipalities as shown in the lists on the inside of the cover, it would be of considerable assistance if the Municipal Officials advise of any corrections that should be made.—Editor.

THE
BULLETIN
Published by
HYDRO-ELECTRIC POWER COMMISSION
of Ontario

190 University Avenue
Toronto

Subscription Price $2.00
Per Year

Hydro-Electric Power Resources Of The Province Of Ontario

By Sir Adam Beck, Chairman,
Hydro-Electric Power Commission of Ontario

FROM time to time round numbers have been presented representing total water-power potentialities for various districts, for various provinces, and for various countries, and when such totals have been given for Ontario it has been customary for some authorities to estimate the total water-power of the Province at about 6,000,000 horsepower. All such estimates must be received with reserve, and this estimate is of relatively little significance for purposes of comparison with other provinces or with other countries, unless, first of all, a uniform basis for comparison has been established.

The character and extent of the data available for many of the Provincial rivers varies greatly, and subsequent investigation of particular streams not infrequently has resulted in greatly increasing early estimates of water-power available from such streams. In other cases, the power available is found to be much below the "estimates" or guesses of explorers and travellers who have considered the streams as though viewed only at their higher stages. It is as yet problematical to what extent various water-powers such as those in the more northerly portions of Ontario may be increased by the utilization of storage, but it is certain that under conditions of actual development, many water-powers will greatly exceed in magnitude the estimates which have, preliminarily, been made of their potentialities.

Frequently, in estimating the water-power available in some other countries, the estimates have been made largely upon a theoretical basis. For example, the potentialities of some power streams have been estimated by considering the general descent of a stream as its developable head, and the amount of stream flow employed has been substantially in excess of what could be depended upon for continuous operation.

Obviously, comparisons of the total

CONTENTS

Vol. XII. No. 4

APRIL, 1925

potential water-power of the province of Ontario could not be made with other countries whose estimate would include a substantial percentage of such hypothetical considerations as have just been referred to.

The Chief Water-Powers

Leaving, then, the question of grand totals it may be asked, "What are the chief water-powers of the Province?" The answer is not in doubt. The potentialities of the Niagara River and the St. Lawrence River outweigh those of any other rivers. Ontario is the owner of Canada's equity in the water-power of the Niagara River and of the international portion of the St. Lawrence River, and even if the actual power that can be developed under the present limitations of Treaty regulations or of engineering considerations be considered, it will be found that the power potentialities of these streams constitute a very large proportion of the available power in the Province. Obviously, the extent to which the water-power possibilities of the Niagara and the St. Lawrence Rivers are included as possible power developments greatly affects the estimated total for the Province.

Next in importance to the Niagara and the St. Lawrence Rivers is the Ottawa River and its tributaries, the more important of which in Ontario are the Blanche, the Montreal, the Petawawa and the Madawaska Rivers. The power on the main stream, which constitutes part of an inter-provincial boundary, is shared by the Provinces of Ontario and of Quebec. This river has been the subject of extensive investigation respecting the regulation of its flow by means of storage reservoirs. Under conditions of controlled flow, Ontario's share of the power available on the main stream, together with that on the tributaries in Ontario, aggregates about 700,000 horsepower.

Other important water-powers are found in the Trent River watershed, tributary to Lake Ontario. There are nearly thirty sites, of which about one-half have been developed with an aggregate capacity of 33,000 horsepower, leaving undeveloped sites with an aggregate capacity of some 30,000 horsepower. Tributary to Lake Huron are water-power streams with an aggregate potentiality at known sites of nearly 300,000 horsepower, of which about 100,000 horsepower is developed. The chief streams are the Mississagi, the Spanish, the Aux Sables, the Onaping, the Wanapitei, the Sturgeon and the French Rivers.

Tributary to Lake Superior are water-power streams with an aggregate potentiality of about 300,000 continuous horsepower. About half of this total is on the Nipigon River, on which an initial development has been made for the municipalities of Port Arthur and Fort William by the Hydro-Electric Power Commission of Ontario. The outflow from Lake Superior through what is known as the St. Mary River constitutes an important water-power site, which has been partially developed. In the extreme west of the Province, the English and Winnipeg Rivers, which flow into the Province of Manitoba, have important water-powers; in Ontario these powers aggregate over 250,000 horsepower. There remains to be mentioned the water-powers of the streams flowing from Ontario into James Bay and Hudson Bay. The more important of these streams from the viewpoint of water-power possibilities are the Mattagami, the Abitibi, the Missinaibi and the Albany Rivers. These streams have not yet been adequately appraised; the total water-power possibilities of known sites aggregate upwards of 1,000,000 horsepower.

What is of much greater importance to the Province of Ontario at the present time than its total water-power possibilities is the fact that in the commercial centres of the Province, where the greater proportion of the population resides, are situated the largest and most important water-powers.

Developed Water-Powers.

The installed turbine capacity of water-power developments already made in Ontario totals about 1,300,000 horsepower. On the Niagara River, developments already made or under construction, have an ultimate rated capacity of over 1,000,000 horsepower. On the international reach of the St. Lawrence River recent engineering investigation shows that a total of at least 1,600,000 continuous horsepower may be developed, of which half, or 800,000 horsepower, belongs to the Province of Ontario. Prospective markets are in sight demanding the early development and supply of this power.

The extensive natural storage of the Great Lakes causes the flow of the Niagara and the St. Lawrence Rivers to be more uniform throughout the year than that of any other large river in the world. This uniform flow coupled with the concentrated falls and rapids on the Niagara and on the St. Lawrence Rivers, and the satisfactory basic engineering conditions for development, are the factors which make these rivers unique for the furnishing of large quantities of hydro-electrical power at low cost.

Recognition of the important place which the water-powers of the Niagara were to occupy in the development of Ontario, led public-spirited men over twenty years ago to take the first steps towards securing for the common benefit of the people, the advantages of this great source of water-power. These early efforts eventually resulted in placing under public control and operation a large proportion of the developed water-power of the Province. Along with the development and widespread distribution of electrical energy under co-operative municipal

ownership, there has also taken place in various parts of the Province a great development of electrical energy for industrial purposes.

The favorable legislation of the Province of Ontario, the low rentals imposed upon bona fide developers of power and many other factors contribute to facilitate the satisfactory utilization of provincial water-powers for the development of new industries. Representative of what has been, and of what may be accomplished by undertakings requiring large amounts of power, are the developments which, during recent years, have taken place on the Ottawa River, the Abitibi River, the Sturgeon River, the St. Mary River, the Rainy River and in numerous other localities where pulp and paper industries have been established. Similarly water-power development has contributed to the success of mining operations as conducted in the Cobalt, Porcupine, Sudbury and other districts of Northern Ontario. Such powers will be requisitioned to an increasing extent in connection with mining operations. Nickel, silver, gold, iron and other metals, as well as many non-metallic minerals, are found over extensive areas in Ontario.

In recognition of the need of power for the development of new territory rich in natural resources such as pulp wood and minerals, the municipalities of the Thunder Bay district—situated at the head of navigation of the Great Lakes—have made an extensive power development on the Nipigon River. The full development of this important power stream will make available an installed capacity of over 200,000 horsepower.

Ontario Protects Her Water-Power Resources.

It is interesting to observe that prior to 1898, no statutory regulations had been passed by the Ontario Legislature to govern the lease or other disposal of water-powers per se, situated upon lands possessed by the Crown. Prior to this date, Crown patents for lands carried with them the title to all water-power situated upon the lands conveyed, and even if, before a patent were granted, a water-power was known to exist upon the land to be conveyed, it was not necessarily referred to in the patent. It must not, however, be inferred that because water-powers were thus granted they were free from legal restrictions, because, whether granted before 1898, or afterwards, all water-powers are subject to certain conditions imposed by law in the interests of navigation, of public health, of lumbering and of riparian owners.

On the 17th. of January, 1898, the Ontario Legislature passed its first special Act respecting water-powers. This Act stated that:

> "Her Majesty, by and with the advice and consent of the Legislative Assembly of the Province of Ontario, enacts as follows: The Commissioner of Crown Lands may reserve from sale any water-power or privilege on the Crown Lands of the Province, and a sufficient area of land in connection therewith for the erection of buildings and plant, together with the right to lay out and use such roads as may be necessary for passage to and from such water-power or priv-

ilege and land, and may, under regulations to be approved by the Lieutenant-Governor-in-Council, make terms and conditions upon which such water-power and land so reserved may be sold or leased and developed."

On the 21st. of June, 1898, under this "Act Respecting Water-Powers," the Lieutenant-Governor approved an Order-in-Council for "Regulations re. Water-Powers," and on the 16th. of January, 1907, these earlier regulations were rescinded, and new regulations adopted whereby supervisory and other jurisdiction respecting proposed water-power developments were vested in the Hydro-Electric Power Commission of Ontario. The policy of the Ontario Government with respect to water-power developments as expressed in later legislation cannot be understood apart from a consideration of the provincial enactments under which the Hydro-Electric Power Commission of Ontario is constituted and carries on its work.

Ontario Legislation Favorable to Water-Power Development

It is not the intention here to enter into any detailed discussion of the legislation involved in connection with water-power developments, but rather to emphasize the fact that the remarkable growth which has taken place in the development and widespread distribution of electrical energy in the Province of Ontario has been greatly aided by the legislation which, at so early a date, was passed in connection with water-power development.

When one considers how water-power development may be retarded through inadequate legislation, the fact just mentioned will be better comprehended. By way of illustration, it may be recalled that, for several years, the development of water-power in the United States was held back on account of the lack of enabling legislation. After the United States Federal Water-Power Act was passed on June 10, 1920, a flood of applications which had been held up swept in upon the Federal Power Commission. Applications for proposed developments aggregating 20,000,000 horsepower were filed before this United States Commission since the 10th. of June, 1920, and to-day water-power development on a gigantic scale is taking place throughout the United States.

In the Province of Ontario, however, the laws have enabled water-power development to take place more gradually and in conformity with a steadily increasing demand. Canadians must not misunderstand the significance of the great water-power developments taking place at the present time in the United States, because the intensity of this movement in the States is to be accounted for largely by the removal of legislative restrictions which, for several years, arrested development.

Present evidences indicate that the future industrial and general commercial development in the Province of Ontario will be such as to require the employment of all the provincial water-power which can economically be produced.

Hydro-Electric Progress In Canada During 1924

(Extracts from Bulletin No. 818, Department of Interior, Dominion Water-Power and Reclamation Service, Ottawa.)

A REVIEW by the Dominion Water-Power & Reclamation Service of the Department of the Interior indicates that in the sphere of hydro-electric and water-power development the year 1924 was one of pronounced activity throughout the Dominion. Not only was a substantial increase recorded in the total installation but many large projects were advanced to such a state that a further extensive increase will be effected during the year 1925. More than 300,000 h.p. was added during the year bringing the total installation in the Dominion to a figure of 3,569,275 h.p., while with the installations nearing completion this figure will be increased by more than 600,000 h.p. during 1925.

Special interest attaches to the activities of the present time when compared with those of a few years ago, in the magnitude of individual developments and the speed achieved in their construction. Where a few years ago blocks of ten to twenty thousand horsepower were thrown upon the market, now plants in excess of one hundred thousand horsepower are brought into operation in a single year. Modern construction methods have also advanced to meet the demand for speedy development so that it is not uncommon for plants of large magnitude to be completed within the space of twelve months.

Practically every province is represented in the year's activities, the details of which are briefly recorded in the paragraphs following. Among these the most outstanding are the activities of the British Columbia Electric Railway Company and the West Kootenay Power and Light Company in British Columbia, the City of Winnipeg in Manitoba; the Ontario Hydro-Electric Power Commission, the Hollinger Consolidated Gold Mines, the Canadian Niagara Power Company and the Backus-Brooks Company in Ontario; the St. Maurice Power Company, the Montreal Light, Heat and Power Consolidated; the Northern Canada Power Company, the Ottawa River Power Company, the Southern Canada Power Company and the Duke Price Power Company in Quebec; and the Nova Scotia Power Commission in Nova Scotia.

British Columbia.

While no new installation may be credited to British Columbia's total during 1924, activities of prime importance were carried forward during the year, the results of which will be effective in considerably increasing the generating capacities of several stations during 1925.

Alberta.

On the Cascade River, near Banff, the Dominion Parks Branch of the Department of the Interior completed and placed in operation a hydro-electric development of 960 h.p., together with a transmission line connecting the plant to Banff where the power is used

for lighting and general power purposes.

MANITOBA.

The City of Winnipeg has ordered equipment which will provide three additional units of 7,300 h.p. capacity each, in its Point du Bois power station on the Winnipeg River. The first of these units is in process of installation and is expected to be in operation about the end of January, 1925.

In connection with the city's hydro-electric enterprise a steam standby plant in combination with a central steam heating and distribution system was completed and put in operation early in October at a cost of $1,250,000. The standby plant which has a capacity of 11,000 k.w. is designed to take care of interruptions which may occur in the supply of hydro-electric power from the Winnipeg River while its boilers in conjunction with two 7,500 kv. a. electric steam generators using surplus or off-peak hydro-power provide steam for the heating of a considerable section of the central business portion of the city.

ONTARIO.

A substantial increase amounting to some 132,000 h.p. was made during the year to the total water-power installation in the province. While the greater part of this was accounted for in the addition of units to existing stations there were also several entirely new developments. These activities embraced all parts of the province, the most important being in the territory served by the Hydro-Electric Power Commission, in the mining territory of Northern Ontario and in the extreme Western part at Kenora.

The Ontario Hydro-Electric Power Commission carried on a vigorous programme of construction throughout the territory which it serves. At the head of the lakes the capacity of the Nipigon Station was increased by the addition of two 12,500 h.p. units bringing the total to 50,000 h.p. Two further units of similar capacity which are being added in 1925 will complete the designed capacity of the Nipigon Station. In connection with the Nipigon development it is of interest to mention a field investigation made by the Commission during 1924 with respect to diverting waters from the upper Albany River basin to Lake Nipigon.

On the Niagara River at the Queenston Station the Commission brought into operation two more 55,000 h.p. units, numbers six and seven. The eighth and ninth units of similar capacity will, it is expected, be installed during 1925 and the final designed capacity of ten units totalling 550,000 be achieved in 1926.

In the Georgian Bay system a second pipe line was completed at the Eugenia Falls development thereby increasing the capacity of the plant by 2,000 h.p. The South Falls Station on the South branch of the Muskoka River is being re-modelled. Two units of 2,200 h.p. each are being installed early in 1925 one of these replacing an old unit of 700 h.p. On the same river at Hanna Chute a short distance above South Falls the Commission plans the construction of a new 1,800 h.p. development during 1925.

The Bingham Chute plant of 1,200 h.p. capacity was completed and placed in operation early in the year, the pow-

er being used in the Nipissing system supplying North Bay and vicinity.

In the Central Ontario System the 6,600 h.p. development at Dam 8 on the Trent River was completed and brought into operation while the 4,800 h.p. development at Dam 9 on the same river will be completed early in 1925. These stations are of special interest inasmuch as they are both being operated by remote supervisory control from the Ranney Falls Station a few miles distant.

In addition to its construction programme the Commission has been active in investigating new sources of power, studies having been carried on at various points, notably on the St. Lawrence, Ottawa, Muskoka and Severn Rivers.

Apart from the work of the Commission numerous activities were proceeded with by other power organizations.

At Niagara Falls the Canadian Niagara Power Company added a new unit of 12,500 h.p. capacity to its hydroelectric station, thereby bringing the total capacity to 121,500 h.p.

In the mining district of Northern Ontario, a particularly active programme of construction was carried out and new installations brought into operation which should overcome the power shortage that has existed for the past few years. For the Porcupine Gold Field two developments were completed and brought into operation, the first by the Northern Canada Power Company on the Quinze River in Quebec, which is referred to more specifically under the Quebec activities and the second by the Hollinger Consolidated Gold Mines Limited at Island Falls on the Abitibi River where 24,000 h.p. was installed. For the silver mining area the Northern Ontario Power Company completed the alterations to the Matabitchuan plant increasing the capacity to 13,200 h.p. Also in the Gowganda district the South Bay Power Company is engaged in increasing the capacity of its plant and storage works. In the Sudbury nickel district the Lorne Power Company added a new unit of 2,750 h.p. to its Nairn Falls Station on the Spanish River and the Wahnapitae Power Company carried well towards completion a new development of 7,000 h.p. on the Wahnapitae River.

In the extreme westerly part of the province the Backus-Brooks Company completed a very satisfactory remodelling of its plant on the Winnipeg River at Kenora bringing the capacity to 12,000 h.p. Most of this power is used in the Company's extensive pulp and paper mills at Kenora.

Quebec.

The year 1924 has been the most active in water-power activities in the history of Quebec Province. This applies not only to new water-power installations actually brought into operation amounting to some 175,000 h.p. but in greater measure to developments actually under construction and nearing completion.

Of the developments completed and brought into operation during the year the largest was that of the St. Maurice Power Company at La Gabelle on the St. Maurice River with an installation of 120,000 h.p. This plant embodying the most up-to-date features of hydro-electric design was constructed

in record time well in advance of the preliminary programme. All of the output has been contracted for by the Shawinigan Water & Power Company.

In the North-western part of the Province the Quinze Power Company, a subsidiary of the Northern Canada Power Company, completed the initial installation of 20,000 h.p. in its development of the Quinze River. This power is being transmitted for use in the Porcupine gold mining area of Ontario.

The Montreal Light, Heat and Power Consolidated added two units of 11,300 h.p. each to its Cedars Rapids plant on the St. Lawrence River, thus completing the designed capacity of this plant of 18 units totalling 200,000 h.p.

On the North River two new plants were brought into operation, the first by the Laurentian Hydro-Electric Company near St. Marguerite, with an initial capacity of 1,865 h.p. and the second by J. C. Wilson Limited, near St. Jerome, with an installation of 1,200 h.p.

Other new installations were those of the St. Regis Paper Company near Godbout on the Lower St. Lawrence, 600 h.p., the town of Buckingham, 600 h.p., the town of Bagotville in the Lake St. John district, 1,350 h.p., the town of Jonquiere in the same district 1,800 h.p. and an addition of 7,500 h.p. to the plant of the Ottawa and Hull Power Company at Chaudiere Falls on the Ottawa River.

A review of the water-power activities in Quebec is not complete without a reference to the very important work being carried on by the Quebec Streams Commission in the creation of storage reservoirs. The Commission has already in operation reservoirs of large magnitude on the St. Maurice and St. Francois Rivers and of lesser size on the St. Anne de Beaupre River. During 1924 the Lake Kenogami reservoir was carried well towards completion. This will regulate the flow of the Chicoutimi and Sable Rivers and when completed in 1925 will have a total capacity of 13 billion cubic feet. The Commission also expects to have the Metis reservoirs completed before the Spring of 1925. It will have a capacity of over 2¾ billion cubic feet and will regulate the flow of the Metis River.

New Brunswick.

No new water-power construction was carried out in the province during the year but studies were actively proceeded with by the New Brunswick Electric Power Commission in connection with the project to develop Grand Falls on the St. John River. This scheme, which involves both international and inter-provincial problems, is being thoroughly investigated from every aspect before a start is made in actual construction.

During the year the town of Campbellton entered into a contract with the Lower St. Lawrence Power Company for a block of 1,100 h.p. from the Company's hydro-electric plant on the Metis River in Quebec. The power is delivered over the lines of the Matapedia Valley Light & Power Company to the Quebec-New Brunswick boundary and from thence to Campbellton, over a thirteen mile transmission line built by the town itself.

Nova Scotia.

Outstanding in the year's activities

in the province were the works carried on by the Nova Scotia Power Commission. On the East River Sheet Harbour the Malay Falls development of 5,500 h.p. capacity was completed and the power brought into service in a number of municipalities in Pictou County. On the same river a development at Ruth Falls with an initial capacity of 6,290 h.p. was completed. This power will be used in a mill being constructed in the vicinity by The Albany Perforated Wrapping Paper Company. The Commission also added a 150 h.p. unit in its Mushamush plant and made extensive repairs to certain of the storage works in its St. Margaret Bay system.

Other hydro-electric activities in Nova Scotia during 1924 included the installation of a 100 h.p. plant for the town of Chester on the East River Chester, the alteration of the town of Bridgewater's plant to include two new 300 h.p. units, one of which replaces an old unit and improvements in the town of Middleton's plant including the addition of a 400 h.p. unit.

Mr. Oliver Heaviside, F.R.S.

RECENT issues of technical journals record the passing on February 4th., 1925, of Mr. Oliver Heaviside, F.R.S., at Torquay, England. Being of a retiring nature and shunning publicity, he lived for many years the life of a hermit, and in extreme poverty, looking only to the reward of having accomplished useful work; his only means in later years being a small Civil List Pension. That Mr. Heaviside was able to anticipate future needs and to demonstrate theories years in advance of their acceptance, is shown in the following extract from "The Electrical Review":

He is therefore known to the present generation only by his works—but those works were of the very highest order of excellence. Mr. Heaviside was a mathematician of great brilliancy; a close student of Clerk Maxwell's electro-magnetic theory, he evolved a mathematical system of his own by which he was enabled to carry his investigations much further in certain directions, particularly in connection with telegraphy and telephony. He demonstrated that the electrical characteristics of a telephone cable could be greatly improved by the addition of inductance—a proposition so directly contrary to the ideas then current that telephone engineers would have none of it. Not until Prof. Pupin corroborated his results and showed how his proposal could be carried into effect, by loading the cable with inductance coils, was it realized that Heaviside had been right all the time. Since then the principle of loading has been adopted on a very large scale, and has made trans-Continental telephony by overhead lines possible, besides greatly improving telephonic communication by cable between this country and the Continent, and between our chief towns.

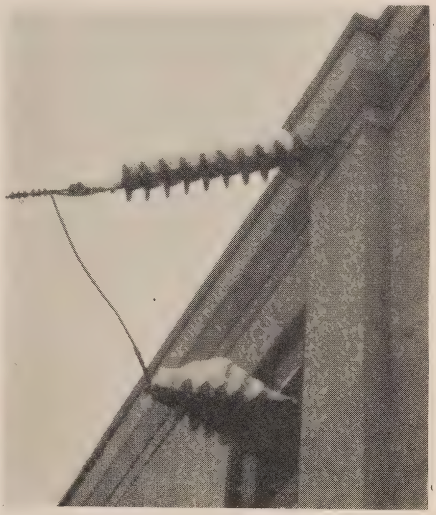
Another notable achievement of

Heaviside's was to demonstrate the possibility that Hertzian waves would travel round the curved surface of the earth instead of following a rectilinear path into space; he showed that, in accordance with Maxwell's theory, sea water possessed sufficient conductivity to guide the waves at the lower end, and that there was probably an ionised layer in the upper regions of the atmosphere which would similarly guide the upper ends. This hypothetical ionised stratum is now generally known as the "Heaviside layer".

The "Electrical World" refers to him editorially as follows:

"With the death of Oliver Heaviside the world has lost one of the greatest mathematical physicists of all time. Known personally to fewer than a dozen people, he had lived a retired life for forty years. He received no conventional education, which largely accounts for his unconventional writings. These fill five large volumes. They treat of a variety of subjects, and their fame is due largely to his papers on the theory of the telephone and the discovery of the distortionless circuit. It was an extraordinary discovery, somewhat like Kelvin's KR law for submarine cables. It was made forty years ago, when there were but few who understood electrical theory. He restated the theory in 1893 in a marvelously simple and clear manner.

He laid the cornerstone for long-distance telephony. Able mathematicians and physicists used his papers, and naturally, however willing to give him credit they may have been, the originator, a recluse who shunned every form of publicity, was eclipsed and obscured. This is the unalterable law of the world, and thus it happened that Heaviside's name is known to but few and his passing away is left almost unnoticed. None the less, one of the greatest creative minds has ceased to be."



NIPIGON GENERATING STATION.

This picture shows a condition we are experiencing in the north country. Service was maintained without interruption with the snow on the insulators. Had the snow been wet and fallen through a smoky atmosphere we might not have been so fortunate.

Electroculture In 1755

THAT there were far-sighted electrical amateurs 170 years ago is proved by the accompanying article and woodcut, which were published in the "Monthly Magazine" dated July, 1755. We are indebted for the extract to Mr. C. R. Lee, of Messrs. Crompton & Co., Ltd., Unfortunately the title-page of the publication, which appears to be a philosophical magazine, is missing; the pages measure 8x5 inches, and we have before us pp. 109 to 124, with two plates, including the one here reproduced full size. From internal evidence it appears likely that this was the fourth issue. The type is, of course, of a quaint old-fashioned character, and the article reads as follows, the letter "f" being here used to represent the old scroll-form letter "s":—

A Defcription of a MACHINE for a *perpetual* ELECTRIFICATION.

AS it is our profefs'd Defign to improve every Difcovery for the Public Good, as far as we are able; and as *Electricity* is now well known to be fomewhat more than a Matter of *mere Curiofity,* inafmuch as it has been fuccefsfully applied to the Cure of feveral Diforders of the *rheumatic* and *paralytic* Kind, and to remove Obftructions and Pains occafioned thereby; alfo it is well known greatly to promote *Vegetation* in *Plants;* and doubtlefs might be found of Ufe in many other Cafes, if it were applied in a *proper Manner,* I mean fo that it might be rendered *conftant* or *perpetual,* and not *momentary* and *inftantaneous,* as in the *common Way* of ufing it. For, if fuch furprizing Effects be producible by its fuddain, and, as it were, fingle Action, what may we expect from the continual Action or Influence of fuch a powerful Agent; that is to fay, from a *perpetual Electrification* of *animal and vegetable Bodies?*

In order to affift in fuch an Undertaking, we here propofe a MACHINE which we think will be fufficient for an Experiment of this Kind. It is the Application of the *Hydraulic Machine,* invented many Years ago, by Dr. *Barker*; with a proper *Apparatus* for perpetually electrifying the Plants and Fruit Trees of an *artificial Garden.* The Defcription of which is as follows.

a, b, is the upright Tube or Body of the Machine, 8, 10, or 12 Feet in Height.

c, d, the horizontal Trunk, thro' which the Water fpouts from Holes at each End, but on contrary Sides.

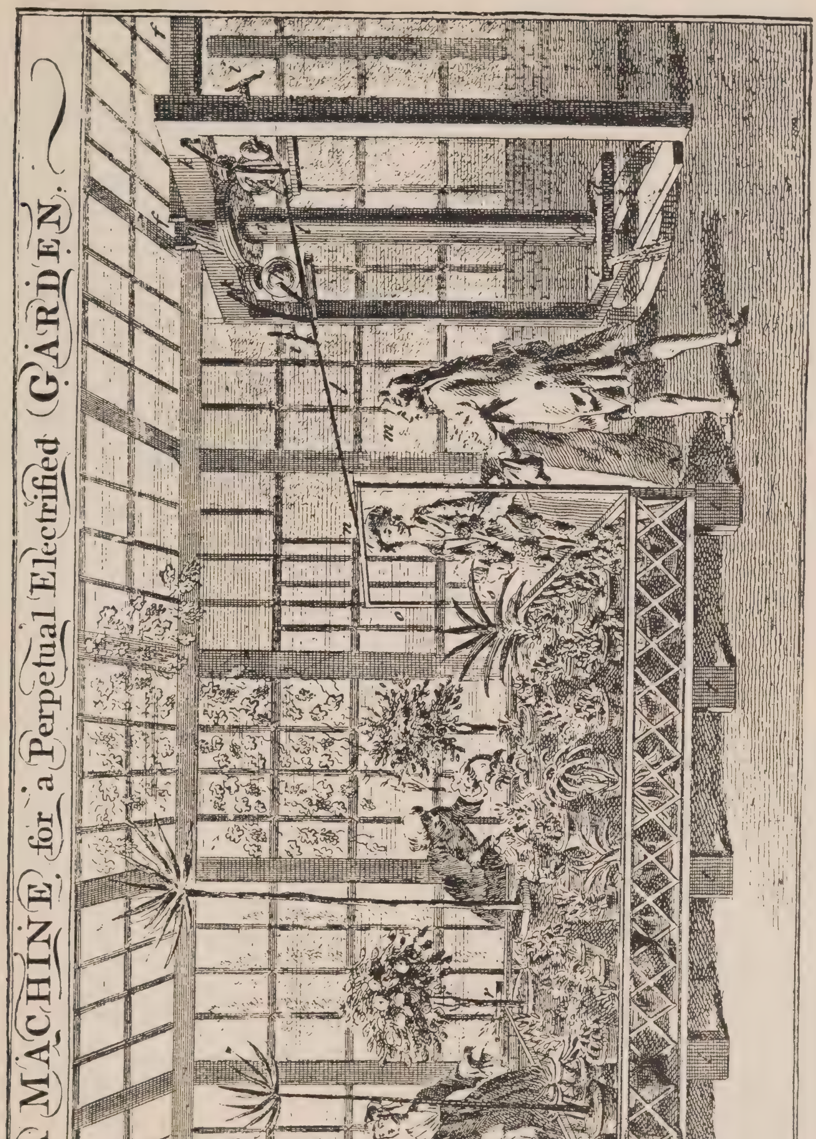
e, e, A large open cylindrical Part on the Top of the Machine, to receive the Water from.

f, A Trough, which brings a fmall Stream of Water from fome adjacent Spring, &c., which turns the Machine.

g, b, Two Glafs Globes, turn'd by the Machine by means of a Cord from the Groove in the outer Part of the Receiver *e, e,* and moving in Grooves of leffer Wheels fix'd on the Axles of the Globes.

i, i, Two Screws, by which the Cufhions are prefs'd againft the Globes for greater or leffer Degrees of Friction.

k, k, Two iron Arms fixed in the



Frame of the Machine, and projecting beyond the Globes, fufpend, on filken Strings, a long Rod of Iron, in Form of T, whofe Part
l, l, receiving the Electricity from

the Globes, conduct it to

m, n, o, A flight Frame of Wood in the Front.

p, q, r, s, The Electrical Garden, placed on

t, t, t, t, &c., fmall Pedeftals, or Pillars of *Wax* and *Rofin.*

In this Garden may be placed in Pots any Sorts of Plants, Flowers, &c., which, when the Machine is in motion, may be conftantly electrify'd. One Globe is enough to be in Motion at a Time; and when that is too hot, the other may be put into Motion; and fo they may be alternatively ufed Night and Day, wihout Ceffation of the *Electrical Effluvia* on the Plants. As a conftant Stream of Water may in moft Places be had, and as the Expence of fuch a Machine and Garden would not be very great, it is much to be wifh't, that thofe who have it eafily in their Power, would oblige Mankind with fome Attempt of this Nature, that they might be fatisfied what could be effected in *Medicine* or *Phyfics,* by a *perpetual Electrification.*

N.B. Eight or ten Feet Fall of Water will be more than fufficient for this Purpofe, and the Diameter of the Tubs, *a, b,* five or fix Inches at moft.

—*The Electrical Review*

Shut In Room With Blazing Cinema

Through a toy cinematograph catching fire, three children were trapped in the pantry of a house at Sedgefield, Durham.

With the flames leaping around them, the children failed to open the door of the room.

Edith Annie Cunningham, aged 5, the daughter of a colliery banksman, went with her stepbrother, George Rennie, aged 11, and another boy of the same age, named Herbert Ward, for a toy cinematograph exhibition in the pantry. The door was closed to shut out all light, and the cinematograph was placed on a stool.

While a film was being shown the door of the cinematograph sprang open and an oil can fell on the floor. At once a large flame shot up and the children were unable to get out owing to a faulty latch which prevented the pantry door from being opened from the inside.

When Henry Sinclair, a friend of the family, went to the rescue the fire had burnt itself out. Edith and her stepbrother were found to have been severely injured by the flames. The girl died at the Country Hospital two days later, and Rennie is still in a dangerous condition.

At the inquest, Mr. John Graham, the coroner, said toy cinematographs were most dangerous playthings.

The father said that the cinematograph was an Aunt's Christmas gift to the boy a year ago.

He, the father, considered it too dangerous to be in the house, and it was consequently given to the other boy, Herbert Ward.

Accidental death was the verdict.

—*The Sunday News.*

Emergency Communication By Radio Telephone Broadcasting

By F.K. D'Alton, Assistant Laboratory Engineer, H.E.P.C. of Ont.

IN the June, 1923, issue of the Bulletin, a description was given of the guided radio telephone equipment operating along the Niagara System power line. At that date, fifteen installations had been completed, and were in use, supplementing the physical telephone throughout the power system.

Since this time, however, the Commission have installed higher power radio equipment at four transformer stations. These are broadcasting installations which further supplement the telephone system, being independent of the existence of the power lines and thus supplying an additional system for emergency communication.

Equipment.

The transmitter in each of these installations is rated at 500 watts, input to the single de Forest Type 2-Q-15 Oscillator tube, and the radiation is modulated by means of a smaller tube, the de Forest type D-10.

The complete transmitter, including the noise filters, is mounted on a panel and in an angle iron framework, shown on the right in Fig. No. 1. Five instruments are provided as indicators of the electrical quantities which require adjustment. The starting equipment for the motor generator set is shown also on the panel.

To the left of the transmitter, on a table, is placed the receiver. This is of the simple regenerative type with two stages of audio frequency amplification.

On top of the transmitter is placed the switching system which enables the operator to quickly change from the transmitting to the receiving connection. The actual transmit - receive switch is shown toward the rear and is operated by means of a vertical rod. This switch is designed to have good clearances and is located in the direct path from the aerial to the set.

Aerials.

The aerials are supported on steel towers 100 feet in height, as shown in Fig. 2. They have a 12 ft. base and are designed to stand a 5000 pound horizontal pull at the top.

The conductors, four in number, are

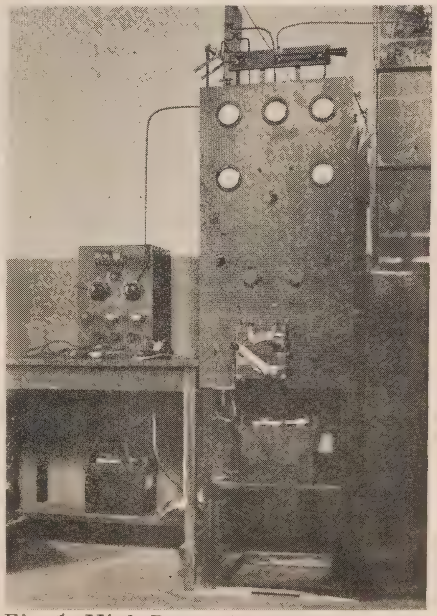


Fig. 1. High Power Radio Transmitter and Receiver Installation.

of 19 strand No. 20 B & S Phosphor Bronze and have a spread of 15 ft. The design of the bridle and arrangement of insulation are as shown in Fig. 3.

The aerials have a length of approximately 240 feet. They are secured at the top of one tower, but at the other tower the cable passes through a pulley and down to a concrete counterweight, Fig. 4. The purpose of this counterweight is to prevent a sleet load from overstressing the aerial conductors, and also to maintain the aerial at the maximum height irrespective of expansion of metal parts.

The complete aerial at Dundas Station, is shown in Fig. 5.

OPERATION.

These Broadcasting sets are installed at Toronto, Dundas, London and

Fig. 3. Bridle and Arrangement of Insulation.

Essex Stations, and all are operated on the wave length of 960 meters. The aerials have capacity of approximately 0.0014 microfarads and receive a radiation current of 5 amperes from the transmitters.

The guided wave receivers are adjustable to receive the broadcast transmitters, and the receivers associated with these transmitters can be tuned to receive the guided wave transmitters, thus making it possible for all of the sets to inter-communicate in any combination desired. One-way communication only is used.

Fig. 2. Aerial Tower at Dundas Station.

Fig. 4. Concrete Counterweight at free end of Aerial.

TORONTO POWER SYSTEM.

These Broadcast sets also can intercommunicate with the five radio installations on the Toronto Power System, which operate on the wave length of 510 meters, namely—at Niagara, Toronto, Burlington, Port Credit and Silverdale.

The first three of these stations use transmitters similar to the one shown in Fig. 1., but of one-half the power. The remaining two stations are of much lower power, using only 10 watt transmitters.

All of these are Broadcast installations, operating on aerials of the type shown in Figs. 6 & 7, which have capacities of approximately 0.0011 microfarads for the 250 watt sets, and of approximately 0.0009 microfarads for the lower power sets at Port Credit and Silverdale. (7 miles S.E. of Beamsville.)

RANGE.

These nine Broadcasting stations are

Fig. 5. Aerial at Dundas Station.

Fig. 6. Aerial at Niagara Toronto Power Transformer Station.

so located that they cover the power systems in Ontario which receive energy from Niagara Falls. Each station is within range of at least two other broadcasting stations, thus completing the chain for communicating in times of emergency, should the telephone system fail to establish communication.

Fig. 7. Silverdale Radio Station.

Recording Arlington Time Signals

By A. L. Wilson, Radio Assistant,
H.E.P.C. of Ont. Laboratories

As a means of checking the accuracy of time-measuring devices, the radio signals from station NAA, Arlington, Virginia, were recorded at the Laboratories on a moving tape.

Arlington is the official radio station of the United States Weather Bureau. Time signals are transmitted twice daily, namely, at 12 o'clock noon and at 10 o'clock at night (Eastern Standard Time) by a series of dots extending over a period of five minutes. Intentional omissions are made to designate half and full minutes. These signals are accurate to 1/10 of 1% of a second, and are the recognized standard for the North American continent.

The continuous wave emissions were received on an outdoor aerial, passed through a regenerative receiver (Fig. 1) consisting of a valve detector and two stages of audio frequency amplification to an ear phone. The sound from this ear phone reached a microphone through a special sound resonator introduced for the purpose of eliminating static interference.

This resonator (R- Figs. 1 and 2) consisted of the ear phone and microphone placed at opposite ends of a cardboard tube, 4-¾ inches in length. The signals were heterodyned to the pitch at which this tube was resonant; (i.e. 700 vibrations per second) thus the sound alone was amplified.

These sound impulses were then received by the microphone, carried through the primary winding of a

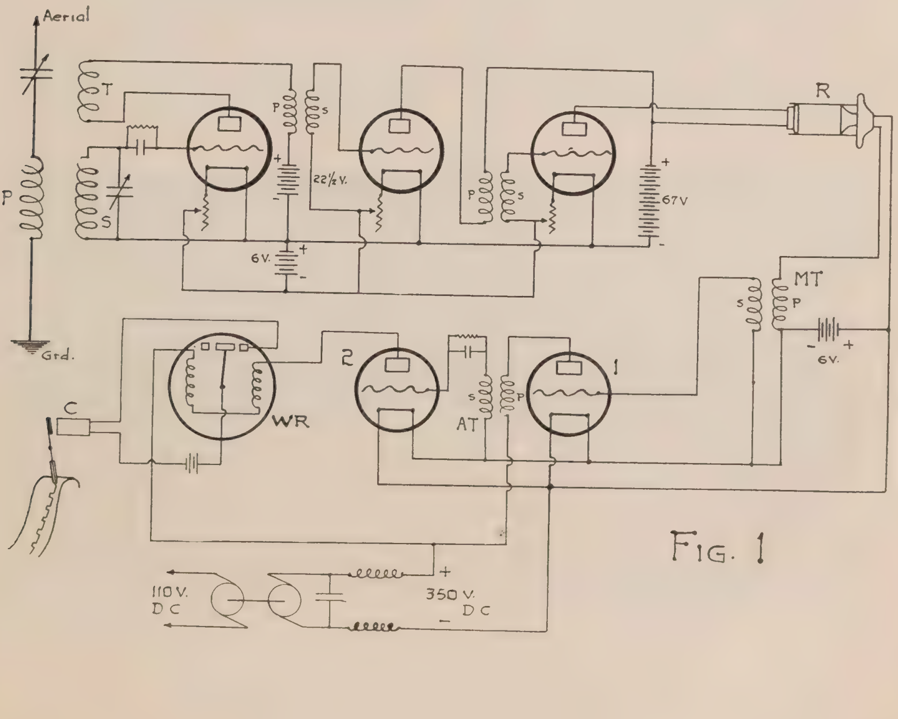


Fig. 1

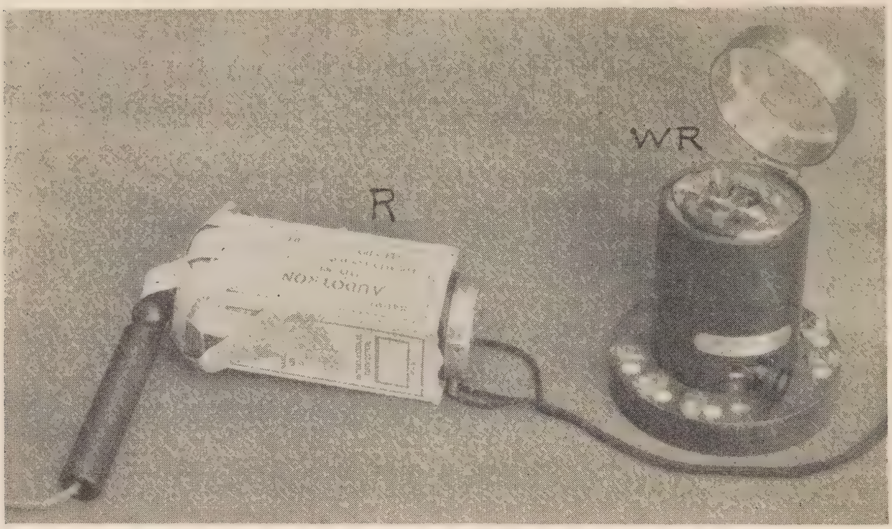


Fig. 2. Resonator and Relay used in Recording Signals.

modulation transformer, (MT. Fig. 1) and by it impressed upon the grid of a power tube, (1-Fig. 1). They were further amplified by the transformer (AT-Fig. 1) and a second power tube, (2-Fig. 1). A very sensitive Wheatstone relay (WR-Figs. 1 and 2) was connected in the output circuit of this valve.

This relay in turn operated one element of the chronograph (C-Fig. 1) and by means of the pen on this element, the signals were recorded on a paper tape moving at a constant speed.

These reproductions are extremely accurate records of the time "dots" transmitted by Arlington, and are shown in Fig. 3 as short dashes, caused by the moving of the pen away from and back to the base line. The dura-

Fig. 3. Tape record of Time Signals. (Read right to left.)

tion of a second is represented by the distance from the front of one dot to the front of the next dot in succession. The omissions of dots occur between the 28th, and 30th, 55th and 60th seconds of each of the first four minutes and between the 50th and 60th seconds of the last minute. Zero hour (e.g. noon) is shown in Fig. 3 by a dash just one second in length.

The tape is read from right to left.

Static was severe, but obviously does not interfere with this record of reception.

Having the chronograph record also on the same tape, the electric impulses from some other time measuring device, gives a very accurate basis for calibration. This scheme may be used for many purposes, being comparatively simple in operation, the utmost in accuracy, and practically free from atmospheric disturbances.

Conduit System, Queenston Generating Station

By J. C. Martin, Electrical Engineering and Laboratory Dept., Station Section, H.E.P.C. of Ont.

THE conduit layout constitutes an important part of any electrical station as it contains the control wiring upon which the operation of the entire plant is dependent.

When completed the Queenston station will be upwards of 550 feet long, and varies in width from 100 feet at the lower floors to about 200 feet at the roof and is over 150 feet in height at the highest point. The control room is centrally located above the generating room and it is to this point that the majority of conduits are run. The lengths of runs vary from less than 100 feet to over 500 feet. Wherever possible conduits were placed in floor slabs or compartment walls and no little difficulty was encountered in avoiding building steel, openings, reinforcing steel, etc. Figs. 1 and 2 show two views of conduit during construction. The number of right angle bends in a single run was limited to four and fewer if at all convenient. Openings in the floors of all compartments housing electrical equipment have been provided at each unit so that a liberal number of additional conduits may be run from any part of the plant to the control room should the need for such arise.

At the South end of the plant a shaft 20 ft. by 5 ft. extends from the lower part of the building to the roof connecting with all intervening floors. This shaft offers a very convenient means of carrying conduits emerging from these floors to their desired locations, and also provides a very convenient place for running miscellaneous air, water and oil piping. Conduits from all parts of the building terminate in a room known as the conduit tunnel This room is approximately 42 ft. wide, 8 ft. high and extends the entire length of the station. Here a series

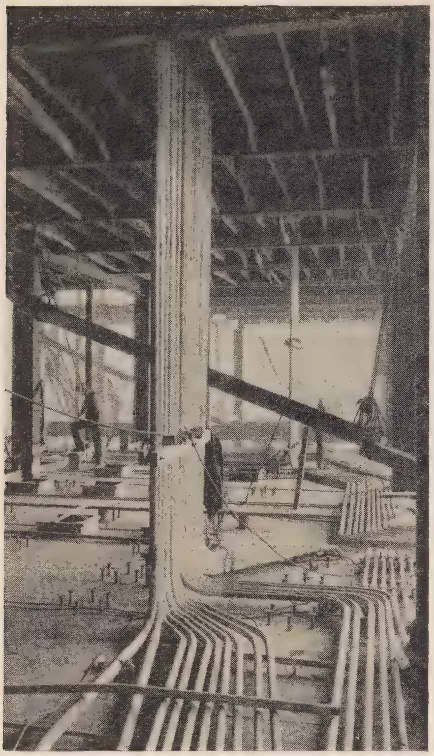


Fig. 1. Conduit during Construction.

of corrugated steel pans are provided for each unit, giving a very flexible arrangement for carrying the control cables towards the control room. The pans are made up of sheet steel in 10 ft. lengths and have grooves, each about 1½ in. deep and wide enough to carry a cable slightly larger than 1 in. in diameter. Structural steel trees secured to floor and ceiling serve as supports for the pans which are arranged in shelves two pans wide and six pans deep. This gives a capacity of 96 cables per unit. Each end of the pan structure is equipped with a steel plate known as the bulkhead which contains as many openings for conduit as there are grooves in the pans. The conduits for any unit are arranged in three groups near the end of the pans, and the connections to the bulkhead are made in the open. This gives an easy method of running any conduit so that the cable will lie in any desired groove.

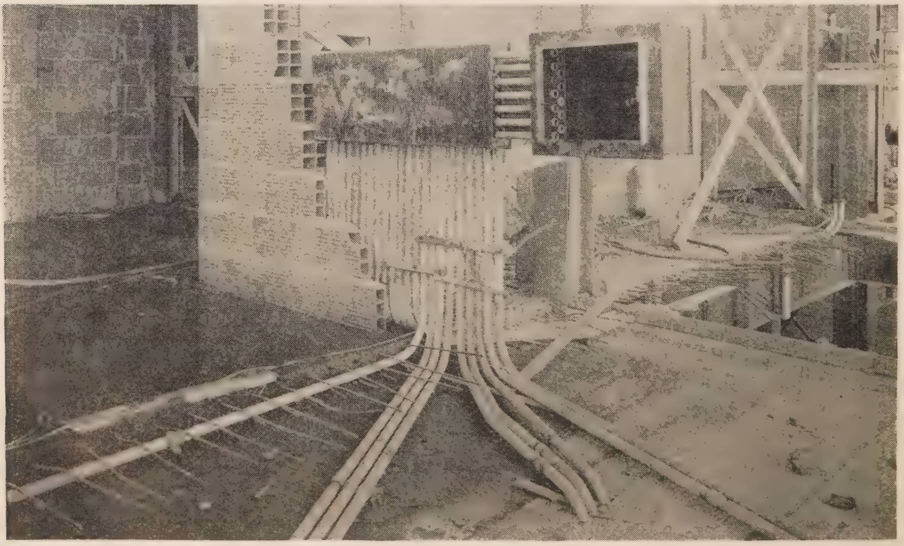


Fig. 2. Conduit during Construction.

From the control room end of the pans conduits are again run on racks to the compartments directly under the control room, and are so arranged that they can be taken off in order to the respective switchboards. Figs. 3 to 8 inclusive show representative views of the pans and the layout of conduits and termination of cables at the switchboard locations.

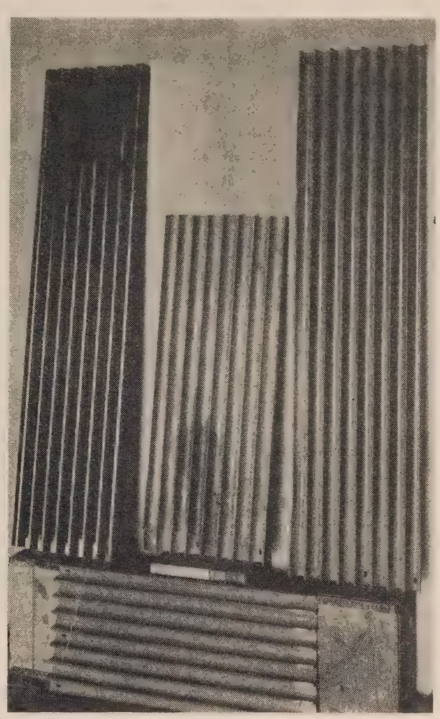


Fig. 3. Control Cable Pans, assorted lengths.

Considerable study was given to the problem of securing good conduit layouts and a reliable system of nomenclature. As Queenston station was laid out on the unit principle it was decided to adopt a unit scheme for conduit designation. The conduits are identified by a unit number such as U2 followed by a serial number such as 127, and a letter subscript e, g, c, indicating a particular branch of the run in question. The designation is written thus U2-127c: generally speaking, the same circuits are run in similarly numbered conduits at all units so that the particular unit number followed by the same serial and subscript indicates the similar circuit at any other unit. A large number of conduits not required for any one unit but serving perhaps the whole station were considered as sta-

Fig. 4. Service Control Cable Pans and Conduit.

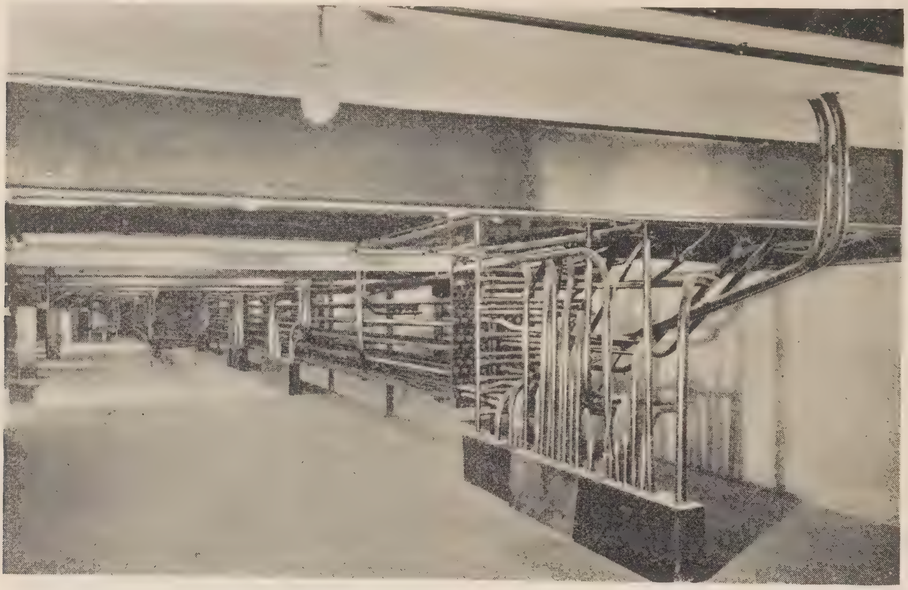


Fig. 5. Control Cable Pans and Conduit, No. 1, 2 & 3 Units.

tion service conduits. These were identified by the letter S followed by a serial number and a subscript viz. S-145g. This class of conduits embraced all station power circuits and control for same, telephone and signal circuits.

Conduit plans were provided for all

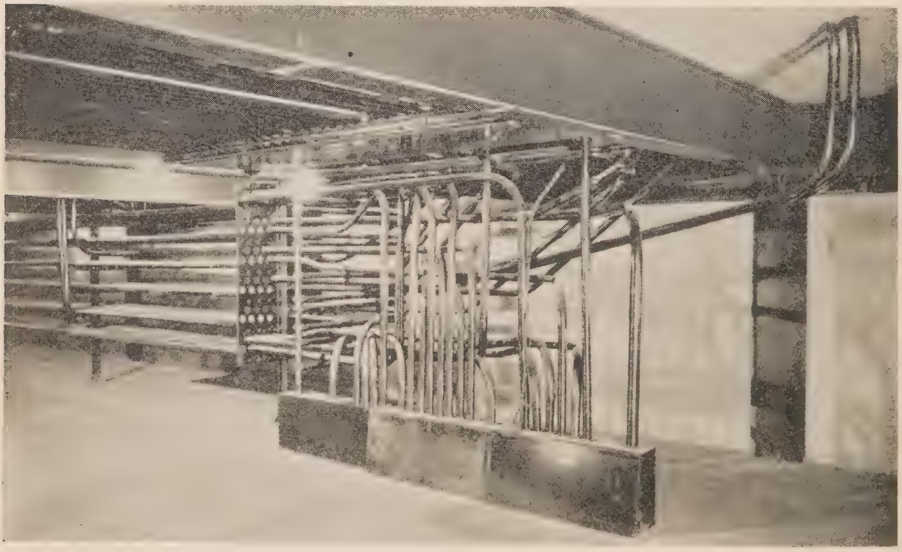


Fig. 6. Control Cable Pans and Conduit, No. 1 Unit.

floors and walls, and all piping was shown as if floor slabs and walls were removed, however, all building steel and openings were indicated. The conduit and cable lists were designed to describe fully the conduit as to length, size, and location, also to give complete information as to the kind of wire or cable required, and lengths of same.

Junction boxes to the number of about 850 were used up to and including No. 8 unit. These ranged in size from 3 in. by 4 in. by 5 in. accommodating 2 conduits to those 10 ft. 0 in. by 2 ft. 6 in. by 1 in. 3 in. with provision for 75 through circuits. They served the dual purpose of junction boxes and locations for panels carrying test links, fuses, knife switches, etc., and were located adjacent to all important electrical equipment such as current and potential transformers, oil switches, etc. As far as possible boxes were made to extend through the walls and back connected switches and fuses were used so that access could be had to both sides of the equipment. Two spare conduits from each important box are run to the control room. Connections from electrical apparatus to the boxes were made with single conductor cables, which were joined to multi conductor lead covered cables if possible at the box nearest to the apparatus in question. In all cases lead covered cables only were used in the pans. The number of different types of multi conductor lead covered cable was kept down to a minimum but the following cables are carried as standard equipment.

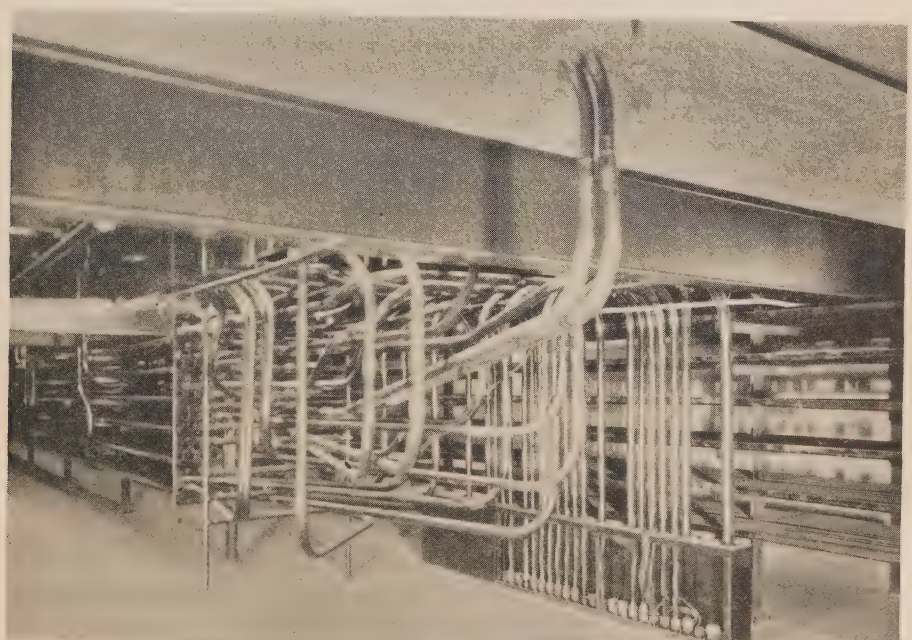


Fig. 7. Control Cable Pans and Conduit Risers, No. 2 Unit.

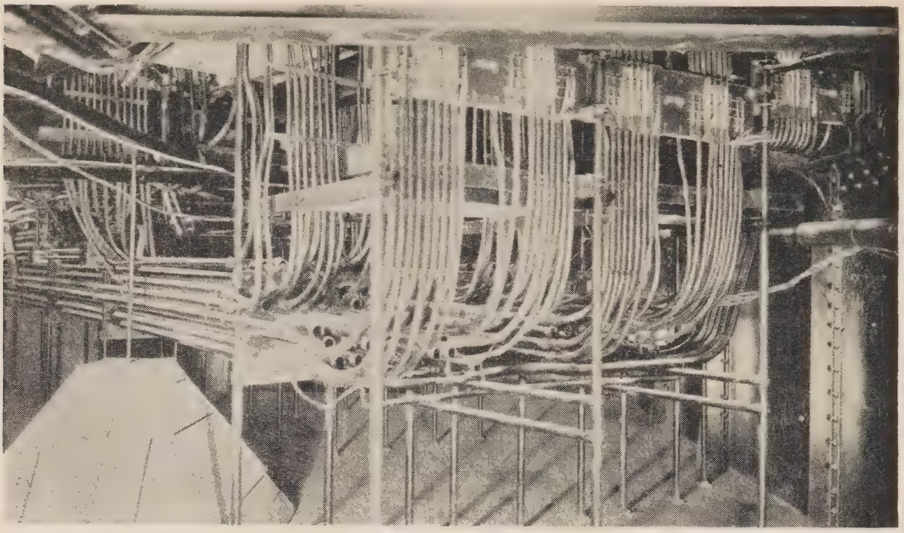


Fig. 8. Control Cable Leads up to Control Panels, No. 1, 2 & 3 Units.

2	conductor	No. 10
2	"	No. 8
3	"	No. 10
4	"	No. 8
5	"	No. 10
8	"	No. 10

At the earlier units no conduit smaller than 1½ in. was used as a precaution against eventualities. As the construction work progressed and more of the problems were more definitely settled it was decided to reduce the minimum size to 1 in. as a standard although in a few instances the ¾ in. size has been used for special reasons. The sizes of conduit were determined by the rule that the ratio of cross section of cable to cross section of conduit should not exceed 0.37. This rule is fairly liberal and cable can be readily pulled through a conduit having not more than four right angle bends, provided that the length of the run does not exceed 100 feet.

The total length of all sizes of conduit approximates 275,000 feet; this does not make any allowance for lighting and heating conduits which if added would increase the total length to nearly 400,000 feet.

Re. Municipal Populations

To enable The Bulletin to give as nearly as possible the correct populations of the Hydro Municipalities as shown in the lists on the inside of the cover, it would be of considerable assistance if the Municipal Officials advise of any corrections that should be made.

—Editor.

Hydro News Items

Central Ontario System

The municipality of Peterborough is contemplating extensive changes in street lighting and has requested this Commission to submit a report covering the installation of a complete new system for the city. The magnetite arcs at present in use on the main streets will remain unaltered.

* * *

Owing to the growth of the range load in Bowmanville, considerable changes in secondary conductors and rearrangement of transformers have become necessary in the residential sections of the town.

* * *

Rural meetings were held at Peterborough and Bridgenorth with a view to establishing a rural distribution system North of Peterborough to serve the rural district, the village of Bridgenorth and Chemong Park which has a large number of Summer residents.

* * *

A rural meeting was held in Bowmanville and was attended by a number of farmers East of Bowmanville who desire electric service.

* * *

Georgian Bay System

Arrangements are being made for draining the marsh adjacent to the Holland River South of the village of Bradford covering portions of the Townships of East and West Gwillimbury and King. Some 7,000 acres will be reclaimed for intensive farming. It is proposed to install a pumping plant operated by hydro-electric power through the Bradford Hydro-Electric System for the purpose of taking care of the surplus water of the marsh, which will be collected in a reservoir. It is estimated that the maximum pumping conditions involve the raising of 40,000 gallons per minute, 5 feet, being the difference in elevation between the water in the collecting reservoir and the elevation of the Holland River. In all probability about 120 h.p. will be required for this pumping plant, which will be operated at "off peak" periods. The number of hours' use per annum of the pumping plant will depend entirely upon the rain fall.

* * *

A new sub-station has been constructed at Gravenhurst and placed in operation on March 26th. This sub-station is fed off the main tie line between the new South Falls plant and Waubaushene, and replaces the old 6600 volt transmission line between the South Falls development and Gravenhurst. Gravenhurst is now served from the main transmission line instead of at generated voltage over its own private line. It is anticipated that Gravenhurst will receive greatly improved service from this station, the

old line having become insufficient to provide for the growing load of the municipality.

* * *

Work is progressing favorably on the extension of the generating station, pipe line, and head works at the South Falls development, covering the installation of two additional 2,000 h.p. units. The first of the new units has already been placed in operation and is now under load and it is expected that the second unit will be in operation in the course of the next three months.

Work is proceeding in connection with the installation of an additional pipe line as well as the construction of hydraulic works for the installation of a third new unit at Hanna Chutes to be controlled from the main South Falls generating plant. The work in connection with alterations to the power house building has been practically completed. When the extension at this development is finished the total output available will approximate 7,000 h.p.

* * *

Arrangements have been made for the construction of a new grain elevator at Owen Sound which will be operated by hydro-electric power. This elevator will require in the neighbourhood of 600 h.p. and provision is being made both by the local Commission and by the Hydro-Electric Power Commission to take care of this additional load.

* * *

St. Lawrence System

The Police Village of Russell has requested an estimate on the cost of power. It is proposed to supply this Municipality from an extension from Chesterville.

* * *

The demand for power in the town of Alexandria is increasing; recently loads of 35 h.p. and 50 h.p. have been added, making the total connected load 400 h.p.

* * *

Thunder Bay System

The work of completing the Nipigon power house and the installation of units Nos. 5 and 6 has been resumed and will be continued until the development has been completed, as per original plans for total capacity of 75,000 h.p. Four machines are in operation at the present time and the two additional units will probably both be in operation by October or November next.

* * *

A.E.M.U.

Minutes Of Meeting Of Executive Committee

A meeting of the Executive Committee of the Association of Municipal Electrical Utilities was held at the office of the Hydro-Electric Power Commission at 2.30 p.m. on Thursday, April 9, 1925. Those present were: Messrs. V. S. McIntyre, President, R. H. Starr, J. E. B. Phelps, R. J. Smith, J. G. Archibald, H. G. Hall, C. A. Walters, O. H. Scott, W. R. Catton, T. W. Brackinreid, J. R. McLinden, G. J. Mickler, S. R. A. Clement, Secretary. The minutes of the last Executive Meeting were read

and approved. This meeting was called for the purpose of arranging for the Summer Convention of the Association.

Mr. N. K. Wagg, Manager, Georgian Bay Tourist Company of Midland Limited, addressed the meeting with the object of having the Association hold its Summer Convention at Parry Sound—the members travelling from Midland to that point through the 30,000 Island District of the Georgian Bay. After hearing Mr. Wagg, it was decided that the facilities offered were not sufficient for holding a convention.

Mr. R. H. Starr, Chairman, Convention Committee, presented a report suggesting two propositions for holding the Summer Convention (1) at the Clifton Hotel, Niagara Falls, Ont., and (2) that it be held during a boat trip from Toronto down the St. Lawrence River and return.

The Secretary reported the results of the canvass to ascertain the feeling of the Association towards holding the convention during a boat trip from Sarnia to Port Arthur and return. The 79 replies received guaranteed 115 to attend if this trip were taken; the Navigation Company asked a guarantee of 300 persons.

It was moved by Mr. W. R. Catton and seconded by Mr. J. R. McLinden, THAT the Summer Convention be held at Niagara Falls, Ont., on June 24th. and 25th., 1925. CARRIED.

The Convention Committee was instructed to proceed to arrange according to the foregoing resolution, and obtain speakers for two convention luncheons and the convention dinner. It was also suggested that delegates so wishing, bring their wives to the luncheons and dinner.

Mr. W. R. Catton, Chairman. Papers Committee, reported on suggestions for papers for the convention. The following were approved and the Committee was instructed to proceed with having them prepared.

Wednesday, June 24th.—Afternoon

Lightning arresters.

Balancing stove elements on ampere rating.

Thursday, June 25th.—Morning

Two papers on Merchandising subjects.

Thursday, June 25th.—Afternoon

Determination of Distribution System losses.

Fire prevention.

Mr. H. G. Hall, Chairman, Committee on Accident Prevention and Health Promotion, reported that the committee had had a meeting and would have a report for presentation at the convention. He asked that the Convention Committee arrange for a demonstration of resuscitation to be given during the convention.

A letter from Mr. H. F. Shearer suggesting that action be taken toward having the pension system of the Hydro-Electric Power Commission extended to apply to permanent employees of the Municipal Commissions. The Secretary was instructed to write Mr. Shearer asking him to present a resolution at the Convention.

The President reported on his findings in reference to the appointment of a successor to Mr. Higman in the Meter Inspection Department at Ottawa. He also told of the action that had been by the O.M.E.A. in reference to the proposed tax on power ex-

ported to the United States, and of the Ontario Legislature concerning the taxing of Hydro shops.

The Secretary reported as to the paid-up membership for the year 1925, and outlined a suggestion to get utilities who have never been members to enter the Association. He was instructed to proceed with the proposed plan and to advise the District Directors of the non-member utilities in their several districts.

It was moved by Mr. W. R. Catton and seconded by Mr. R. J. Smith—THAT the Secretary send Sir Adam Beck a telegram expressing the regret of the Executive Committee on account of his illness and the hope for his speedy recovery, and also that he telegraph Sir Adam Beck some flowers.

CARRIED.

The meeting then adjourned at 4.30 p.m.

An Appreciation

A letter received recently by the Commission from the wife of a rural consumer contains a paragraph that makes us feel that our efforts at relieving the drudgery of the housewife are not without results. Much has been said about the benefits resulting to the farmer by his using electricity, that he is permitted to increase his production and perform certain operations with less labor. But the farmer's wife is often required to perform her duties under none too favorable conditions. Anything that can be done to ease the strain under which she must work is, we believe, as important as assisting her husband to make greater returns. The statement is as follows:—

"And now just a word of appreciation and gratitude to the Commission for this service. I wonder if you realize what it means to the rural housewife. It revolutionizes her whole life."

Some English Lighting Rates

The following extracts from "The Electrician" are somewhat of interest to us in that they show charges for electric lighting service that would hardly be deemed possible in Ontario, when considering the size of the municipalities to which the same apply. The statements are:

The Tisbury Electric Supply Co., Ltd., having increased the price of electricity from 1s. to 1s. 3d. per kw-hr., the Tisbury Guardians have decided to invite quotations for generating plant, etc., and reports on generating costs.

All the London electricity supply undertakers whose charges for energy for lighting exceed 6d. per kw-hr., have been asked by a Committee of the London County Council whether any reduction will be made in the near future.

A.M.E.U. Convention at Niagara Falls, Ont., June 24 and 25, 1925

List of Electrical Material, Devices and Fittings

Approved by The Hydro-Electric Power Commission of Ontario in March 1925.

Appliances

S. F. Bowser Company, Ltd., 54-68 Fraser Ave., Toronto, Ont.

Electrically-lighted Gasolene Pumps. "S. F. Bowser Co., Ltd."

* * *

The Elliott Addressing Machine Co. (Submittor), 61 Victoria St., Toronto.

Elliott Addressing Machine Company, (Mfr.), 143 Albany St., Cambridge, Mass.

Electric Addressing Machine.

* * *

Wayne Tank & Pump Co. of Canada, Limited, 165-87 Dufferin St., Toronto, Ont.

Electrically-lighted Gasolene Pumps. "Wayne Tank & Pump Co. of Canada, Limited."

* * *

Superior Electrics Limited, Pembroke, Ont.

Electric Ranges, Low Oven Type, Cat. Nos. 483, 484, 563, 564.

* * *

Savage Arms Corporation, Utica, N.Y.

Electric Washing Machine. "Savage."

* * *

Cassidy's Limited (Submittor), 47-55 St. Paul St., W., Montreal, Que.

Superior Electrics Limited (Mfr.), Pembroke, Ont.

Electric Pressing Iron, Cat. No. S10, "Cassidy's Limited".

Electric Toaster, Cat. No. P122, "Cassidy's Limited".

* * *

*Nizer Corporation, 7424 Mackie St., Detroit, Mich.

"Nizer" Automatic Electric Ice Cream Cabinet.

* * *

*Cutler-Hammer Mfg. Co., The, 144th St. & Southern Blvd., New York, N.Y.

Chocolate Warmer.

Soldering Irons, Code Nos. 5201, 5202, 5202R, 5203-11 incl., 5212, 5212R, 5213-15 incl.,. 5218-24 incl., 5226-27, 5229, 5250-51.

Soldering Fixtures, Code Nos. 5301-04 incl.

Automatic soldering iron racks, Code Nos. 5252-61 incl.

"C.H."

* * *

*National Electric Mfg. Co., Pittsburg, Pa.

"Syntron." Electrically - operated Hammer.

* * *

Switches

*Bryant Electric Co., The, Bridgeport, Conn.

Flush Switches (As listed on Underwriters' Laboratories card dated Dec. 2, 1924.).

* * *

*Duncan Electrical Co., Ltd., Montreal, Que.

Push Flush Switches. "Duncan."

single pole, Cat. No. 200; three-way, Cat. No. 203.

* * *

*FEDERAL GAUGE CO., THE, 564 W. Adams St., Chicago, Ill.

Automatic Switches—Float Type and Pressure-operated Type. "Mercoid."

Temperature Regulating Appliances. "Mercoid."

* * *

*MINNEAPOLIS HEAT REGULATOR CO., Minneapolis, Minn.

Temperature Regulating Appliances. (As listed on Underwriters' Laboratories card dated October 31, 1924).

* * *

*JOHNS-PRATT CO., THE, (Div. Colt's Patent Firearms Mfg. Co.) Hartford, Conn.

"Noark" service entrance switches, Cat. No. 3667, Special No. 6081.

Enclosed Switches (As listed on Underwriters' Laboratories cards dated October 25, 1924, and January 6, 1925).

* * *

Fixtures

THE H. E. RAINAUD COMPANY, Meriden, Conn.

Portable Electric Lamps. "Rainaud."

* * *

Fittings

*CIRCLE F. MFG. CO., (Submittor), 10 Prince St., Trenton, N.J.

FREEMAN ELECTRIC CO., E. H., (Mfr.), Trenton, N.J.

Fuseless Attachment Plugs, Cat. Nos. 101-02, 110-11, 115-17 incl. "Circle F."

* * *

*DUNCAN ELECTRICAL COMPANY, LTD., 2 Inspector St., Montreal, Que.

Duplex Flush Receptacle, Cat. No. 222.

* * *

*JOHNS-PRATT CO., THE, (Div. Colt's Patent Firearms Mfg. Co.) Hartford, Conn.

Plug Fuse Casings "Noark" (As listed on Underwriters' Laboratories card dated April 10, 1916).

* * *

*JOHNS-PRATT CO., THE, (Div. Colt's Patent Firearms Mfg. Co.) Hartford, Conn.

Cabinets and Cutout Boxes—Weatherproof (As listed on Underwriters' Laboratories card dated January 16, 1925).

Medium Base Sockets. Keyless, Cat. Nos. 1143, 1150, 1144, 1153, 17086, 17090, 17098, 17102, 60666. "J.P.Co."

Cartridge Fuse Cutout Bases (As listed on Underwriters' Laboratories cards dated January 16, and 17, 1925).

* * *

Miscellaneous

*JOHNS-PRATT CO., THE, (Div. Colt's Patent Firearms Mfg. Co.) Hartford, Conn.

Insulating Materials. (As listed on Underwriters' Laboratories cards dated January 16 and 17, 1925).

* * *

HALE BROTHERS, 435 St. Paul St., W., Montreal, Que.

Fuseless Attachment Plugs—Cord Sets.

* * *

*These devices are under the Underwriters' Laboratories re-examination or label service.

THE BULLETIN

Published by
HYDRO-ELECTRIC POWER COMMISSION
of Ontario

190 University Avenue
Toronto

Subscription Price $2.00
Per Year

Power Output in 1924

ACCOMPANYING the April 25, 1925, number of the ELECTRICAL WORLD is a tabulation showing the output for the past year of the largest generating and distributing companies in the United States and Canada. Referring to the tabulation editorially it is stated:

"The annual statistics compiled by the ELECTRICAL WORLD on the electric light and power companies which generate in excess of one hundred million kilowatt-hours of electrical energy each year are worthy of study. Each of the companies constitutes a superpower system in itself, because one hundred million kilowatt-hours is more than many states and some nations consume, and surely, a state-wide system is a superpower system. But what shall be said of those super-super systems with outputs in excess of a thousand million kilowatt-hours yearly? Nowhere else are they to be found except on the North American continent."

Of the one hundred and twenty-two systems listed, fifteen exceed the thousand million mark. Of these latter, three are Canadian with that of the Hydro-Electric Power Commission of Ontario, the greatest of all. On the basis of peak loads the Hydro Commission was exceeded only by the Commonwealth Edison Company and the Edison United

CONTENTS

Vol. XII. No. 5
MAY, 1925

Companies, New York. These latter two companies also exceeded the Hydro Commission in total generating capacity, while the Commission has the greatest capacity in Hydro Plants.

The following tabulation shows the amounts for the five Canadian systems included in the tabulation referred to, together with those of the five largest systems in the United States:

SYSTEM	Generator rating (total kv-a)	Peak Load Kw. (Instantaeous)	Output for year, kw-hr.	Average Load in 1924 kw.
CANADA:				
Hydro-Electric Power Commission of Ontario	745,092	576,403	3,026,615,156	344,560
Shawinigan Water and Power Company	322,450	347,448	2,066,066,762	235,000
Montreal Light, Heat and Power Company	......	221,060	1,210,105,965	150.000
British Columbia Electric Railway Company	104,100	75,200	300,456,350	34,298
Winnipeg Municipal Hydro-Electric System	70,750	46,065	200,520,080	22,700
UNITED STATES:				
Niagara Falls Power Company	600,090	......	2,858,482,674	325,419
Commonwealth Edison Company	769,000*	717,000	2,787,090,000	317,000
Edison United Companies, New York	841,000	615,283	2,056,432,473	234,750
Pacific Gas and Electric Company	459,975*	343,701	1,887,113,680	214,835
Southern California Edison Company	428,600*	330,660	1,664,151,512	189,453

* kilowatts.

Preliminary Water Power Investigations

By A. M. Beale, Dominion Water Power and Reclamation Service

(Paper Read before the annual meeting of the Association of Dominion Land Surveyors at Ottawa.)

IT is estimated that under ordinary minimum flow conditions the water power resources of Canada approximate 18,000,000 continuous 24-hour power, that for at least six months of the year 32,000,000 is continuously available, and that in accordance with current practice to date in the Dominion these resources will justify an ultimate turbine installation of over 40 million horse power. By far the largest portion of these power resources are to be found in territory far removed from coal bearing areas and it is quite apparent, therefore, that, great as has already been the contribution of water power to the development of the Dominion, this contribution is destined to grow to very much greater proportions in the future.

The development of water power along modern lines is practically the growth of the present century. The turbine installation in Canada to date already exceeds 3½ million horsepower and the current year will, if the construction schedules now in effect are carried out, see an increase in this figure of more than 600,000 horsepower which will be by far the greatest increase recorded in any single year in the history of Canadian water-power development.

It is quite apparent, therefore, that water-power is very much a live issue at the present time and that an intensive investigation of undeveloped resources must be carried on in order that adequate data may be available in regard to each power site as the time for its development approaches.

Broadly speaking, water-power is the product of two natural features —climate and topography—the one variable and the other constant until interfered with.

The investigation of water power involves three operations, hydometric surveys to establish the amount and time distribution of water supply, land surveys and soundings to determine the land and under water topography, and hydraulic engineering studies, both to design and locate works and to accurately estimate their effect on the flow and surface levels of the river. These three phases are inherent to water-power investigation and the study involves all three jointly. For example, the hydrometric studies determine the quantities of water which are available at different seasons of the year and also the pro-

vision which must be made to pass maximum flow; the surveys and soundings permit of a location and design of the works, but no final design can be fixed until hydraulic studies of channel characteristics and governing water elevations under various discharges, both above and below the proposed site, are determined. These hydraulic, hydrometric and design studies react on one another and a final satisfactory result cannot be obtained until all three factors are harmonized, and while the natural procedure is to collect hydrometric data first and then proceed with the surveys and soundings, the engineer in charge must be qualified by training and experience to appraise the problem as a whole at the outset and lay his plans accordingly.

No two water-power sites or rivers are identical, each must be investigated on its own merits and special attention given in each case to the particular problems requiring solution. Again the scope of investigation varies in each case in accordance with the extent of the power available, but the course of the investigation will depend largely upon the exigencies of the case. If a market is clamoring for power every effort must be made to secure all the data required and complete all designs and studies as quickly as possible, but if no adequate market is anticipated for some years the investigation can be prosecuted along more leisurely lines, concentrating during the early period in securing records of the constantly changing flow of water, precipitation and temperatures, and ice conditions.

It is evident, therefore, that the engineer in charge of an important investigation must be well equipped with technical knowledge, experience and judgment, for he has to lay out the scope of the investigation, instruct and supervise the parties working in the field and, having secured the preliminary data, lay-out the general scheme of development. He is then in a position to make further designs and calculations and to secure such additional data as may then appear necessary in order that he may be able to finally lay out a scheme which will secure a safe, efficient and economical development of the power resources of the river. The scheme fully supported by plans, designs and a report is the final goal of the investigation. The project is then ripe for the financial interests which, having satisfied themselves that it has commercial possibilities, refer the matter to their own engineers to check up the findings of the report and, if satisfactory, prepare working plans and specifications as a basis for letting contracts.

Upon receiving instructions to make an investigation the engineer in charge makes a reconnaissance trip of the main river and principal tributaries and, assuming, for the purposes of this paper, that the river has been quite unstudied, he endeavours to familiarize himself with the general conditions in order that he may select the best places for gauging stations and for the location of gauges, and also lay his plans for the field work necessary to secure full information of the exact location and extent of each natural

fall, foundation conditions, soundings and other necessary particulars regarding the water-shed, including size and location of lakes and their possibilities as storage reservoirs, and other details such as settlements, forests, swamps, etc. It may, of course, be necessary after a tentative scheme of development has been laid out to secure other information on the ground, but this will be dealt with later.

Hydrometric Survey

The first effort in every case must be concentrated upon securing stream flow records and, if possible, these should be secured many years in advance of any prospect of development. The more important the river the longer the period of records required, for a river of any size at least 10 years may be considered the minimum, while 35 or upwards is desirable and, in fact, I doubt whether any engineer has had records for as long a period as he would like. In a number of cases, including some in Canada, a water-power development has proved a complete or partial failure because it was undertaken before sufficient flow records were available. People, rendered optimistic by the flow occurring during two or three high-water seasons, have gone ahead with developments which have been condemned, even before completion, by the discovery that the water supply is much less than that indicated by the few measurements previously taken.

The Dominion Water Power and Reclamation Service has established a Dominion Hydrometric Survey, co-operating with the various provincial authorities, operating from coast to coast which has measured and is obtaining daily (or regularly at longer intervals) records of the flow of most of the streams of any magnitude throughout Canada. In addition to its own records the Survey has collected all records previously secured by provincial or other authorities, companies or individuals, with the result that there are available continuous records for a number of years covering most of the streams that are, or may be, required for power purposes. This being the case the absence of flow records that was so serious a handicap to development 10 or 15 years ago no longer obtains and it is unlikely that in the future any such trouble will be experienced, for, not only are records maintained on rivers already within the scope of the Survey, but new rivers are being steadily added to the list of those measured in the endeavour to keep well ahead of any possible requirements.

The ideal location for a Hydrometric metering station is one where the river flows between parallel banks for a few hundred feet above and below without change of direction and without obstructions in the bed. If the cross-section of the river at this point is regular, so that the water at all stages is neither excessively shallow nor deep and has flow which is perceptible without being sufficiently great to produce whirls or eddies, the station will be ideal for average open water condi-

tions. In order that the section may be equally desirable for all conditions it should be located above a waterfall or permanent "control point" so that it will not be effected by backwater from ice jams or high water. Under these satisfactory conditions each elevation of the water surface will correspond to a definite quantity of flow.

Other desirable features are that the metering station shall be easy of access, that there be facilities for the establishment of a gauge at or near the section and that an intelligent and reliable gauge reader be available nearby to regularly read and record the gauge height.

If conditions justify the expense it is desirable to establish an automatic gauge which will continuously record the gauge height. These gauges have to be visited once a week or once a month, as the case may be, to be rewound and to replace the gauge sheet. Automatic gauges are particularly necessary below power-houses or artificial control works where the flow of the river is subject to frequent and wide variations incidental to operation of these works because a true record of flow can then only be secured by continuous readings.

Upon the establishment of the gauging station frequent measurements of the flow of the river by current meter are made at all stages of the river and under both open water and ice conditions, special effort being made to secure records at both ends of the scale, *i.e.*, during extremes of high or low water. These measurements are carefully tied into the gauge height and a rating curve for the stations is established by plotting the flow of the river in second-feet against the height of the gauge in feet. Once this rating has been established it requires merely a straight conversion from the rating table (drawn up from the curve) to record the flow from the gauge height. Periodically the datum of the gauges is checked by level against a convenient bench-mark established for that purpose so that no shifting of the gauge shall go long undetected and periodical meterings are also taken to make sure that the section is remaining constant and that the rating curve remains applicable.

It is seldom that an ideal section can be secured and it is for the engineer to select the station that most nearly fulfils requirements. On an important river a number of such stations are required, both on the main river and on principal tributaries, particularly at the outlet of any lake that is likely to have storage possibilities.

Field Surveys

These are undertaken to secure the field data, other than hydrometric measurements, required for the consideration of the whole problem and to form the basis for the general plan of development, design of structures and hydraulic studies which will have to be completed before the final report and plans can be prepared.

In dealing with small rivers where the probable power resources are not of the first importance, recon-

naissance methods are employed and the engineer in charge of the actual survey must exercise judgment in obtaining the essential information as rapidly and economically as possible.

Instrumental work is reduced to a minimum and is usually confined to the actual falls and rapids where a rapid stadia traverse is carried out and levels run with the transit. Between falls and rapids the drop is usually estimated in feet per mile and the height and nature of the banks carefully noted. The engineer making the reconnaissance must of necessity bear in mind the possibility of combining the drop in two or more falls and rapids, either by erecting sufficiently high dams or by the removal of the obstruction causing these controls, or both. In the course of his work he will be able to reach tentative conclusions as to the concentrations possible, and must secure in the field sufficient topography and soundings to enable him to confirm or modify these conclusions. The elevation of high-water marks and the dates and elevations of water levels above and below control points are noted.

If the river has not yet been covered by the hydrometric survey, meter measurements are made and if there are nearby settlers available gauges are established and arrangements made for a gauge reader to forward to the District Office records of the readings of the gauge.

Later on in this paper an outline of the water power reports required is given as laid down in Water Resources Paper No. 10, which is a general guide for the compilation of water power reports and the securing of field data. Using this guide as a basis the engineer will not have much difficulty in carrying out his work and will be careful to gather in the field all the data essential to the preparation of his report, although he must, of course, exercise judgment as to how far he may modify the outline to suit importance of the stream and the purpose for which it is being investigated.

Examination of an Important River

Where an important river is to be investigated it is necessary, as has already been stated, for the engineer in charge to make a rapid reconnaissance for the purpose of laying out the plan of attack and instructing the field party or parties.

In making this reconnaissance, the engineer will carefully study the conditions of the river as a whole, and from experience will arrive at certain tentative conclusions as to where the drops can be concentrated to obtain the best utilization of the power possibilities of the river. He will be able to select the probable location of power dams, the places where channels must be cut or the river bed improved so as to increase the cross-section and can, therefore give definite instructions to ensure that all topography, borings and soundings that are necessary, not only for the design of works but also for detailed hydraulic studies, are secured.

The first undertaking is the organization of a small level party which starts from the nearest reliable

bench-mark available and carries a line of levels (run twice) along the river,establishing bench-marks above and below each fall or rapid and at convenient intervals between. Where a map is available the location of these is carefully spotted but usually it is necessary to carry a compass and stadia traverse simultaneously to locate these bench-marks and to provide a reasonably accurate profile. Water levels are noted together with the date at frequent intervals, also any high water marks; in fact, the immediate and persistent recording of all data bearing on water levels and flow must be considered essential. In establishing bench-marks every effort should be made to ensure that these be easily found at any future time under any conditions, and careful sketches or photographs showing the location of these bench-marks in relation to nearby conspicuous natural features is of the greatest importance.

Where speed is essential and a transit party is expected to follow shortly, temporary bench-marks consisting of a nail on a nub cut in a convenient root of a large tree is quite satisfactory. The tree itself should be blazed and the number and elevation of the bench-mark scribed thereon.

When the transit party arrives a permanent bench-mark consisting of a bronze cap sunk into a hole drilled in some convenient rock or permanent structure is substituted. Or, if no transit party is expected, the level party establishes these bench-marks. Tree bench-marks are difficult to find after a year or so as blazes become discoloured and passersby seem to have a mania for testing their axemanship by chopping the nail bench-mark out of the root.

Where lake expanses or stretches without perceptible current are encountered, levels are conveyed by water transfer.

The transit party makes a contour survey of the whole power reach of the river aiming to obtain accurate topography at the various power sites and contenting itself with less accurate contours of the river banks between the sites where the main interest is the controlling contour for any concentration, the areas to be flooded and the possibility of constructing dykes across any depressions. In most cases, by carrying his height of instrument and using stadia, all the required information can be secured from a shore traverse, or better still, a traverse carried along the ice in winter time. Topographers using hand levels each accompanied by a rodman carrying a rod graduated in feet and tenths and using a short metallic tape carry the elevations and distances up the bank after having been located on a contour on the shore by a stadia shot from the transit. A recorder stationed with the transit records all bearings and distances, sketches in the topography locating the contours thereon as handed to him at every station by the topographers.

The maximum development of the power resources of a river would be obtained by concentrating the natural fall at a series of sites at each of which the headwater level will be the same as the tailwater level of the site above. The possi-

bility of so doing depends on the construction conditions at each site, the height of the banks between the sites and the character of the river channel in each reach. It must be borne in mind that the total discharge of the river must pass down it and that at any section where the cross-section of the channel under the new conditions is restricted a certain gradient will be required to pass the flow unless the restriction be removed. In order to determine what the flow characteristics will be and to determine either what gradients will oocur or what excavations will be necessary careful soundings must be made to determine cross-sections and bed formation and also studies made of the coefficients of roughness under natural conditions so that complete data will be available for study when reaching a decision.

Where a fall occurs in a series of pitches and rapids extending for some distance along the river it may be necessary to run land lines with transit and chain. In such cases stakes are set at every 100-ft. station and at all decided changes of slope. A leveller follows and notes the height of ground at every stake and he in turn is followed by topographers equipped with hand level, rod and metallic tape, who locate the contours on either side of the traverse lines. These traverse lines are so located that they will take in all the features required and be sufficiently close together for the topographers to entirely cover the area.

The location and character of rock or impervious material suitable as foundations for the work is essential information. Where this material is overlaid with other material sufficient wash borings must be secured to definitely locate foundations over the whole area where works may be constructed. Sufficient diamond drill borings must be made to satisfactorily determine the character of the foundations, solid granite is not by any means always present, and the thickness and character of the rock, hardpan or clay foundations, must be known and fissures in rock or pervious strata below the impervious strata detected if these exist. A power development involves heavy capital expenditure which cannot be undertaken until it is definitely proved that a permanent structure can be safely undertaken and that any untoward foundation conditions can be adequately provided for at reasonable cost. The question of foundations calls for high engineering qualifications and in some cases it is necessary to retain the services of a recognized consulting authority to advise thereon.

Here again water levels and high water marks are noted at every opportunity.

When these surveys are completed it is possible to make complete contour plans of the whole power reach of the river under examination and with these and the water supply data available it is possible to commence the office analysis and designs with a view to preparing a complete report upon the river.

Hydraulic Studies

The stage is now set for the beginning of the Hydraulic studies

which must be carried out under the supervision of the enginner in charge and involve a great deal of work and require considerable technical skill and experience.

Careful examination of the plans of the river will probably suggest one or more ways of combining the various drops of the river to secure complete utilization of the available power by a series of developments each of which will be economically sound.

Having selected the most promising of these schemes it becomes necessary to prepare general designs of the works at each site. These designs are required as a basis for estimates and involve the preparation of a lay out of a power house sufficient to accommodate the generating machinery, spill-way and sluices sufficient to discharge the greatest flood that is liable to occur without danger to the structures and without causing an undue rise of the water level above the structure. Other structures that may be required are non-overflow concrete dam, earthfill, levees, ice sluices, timber slides and fish ladders. In laying out his design the engineer must give due attention to the foundation conditions, that is the nature and location of the rock or, if rock is not available, of the possibility of securing sound foundations. He must design his works to best suit the conditions and facilities at the site and consider the problem of unwatering the site and providing for the flow during construction. One site might be best adapted to a concrete gravity-type dam, another a hollow dam, another an arch dam or suitable material may be available nearby for a hydraulic fill dam. In some cases a power canal or penstock is required with intake works, stand pipes, etc.

In passing it may be mentioned that it is by no means uncommon for an engineer to prepare a practically ideal lay-out and then be forced to select another site less desirable and economical of materials, but necessitated because the first site offers exceptional difficulties for unwatering the site or in taking care of the flow of the river during construction.

It is frequently found that a fall can only be combined with others to form a good development by removing it. The problem in this case is to design a channel through the barrier producing the fall so as to bring the upper water level to the lower and consequently by lowering the level of the intervening reach adding that head to the site next above. This will necessitate careful soundings, not merely of the fall itself but in the reach above, to discover whether there are any other narrows or shallows which will control the reach to be lowered when the barrier at the fall is removed. In designing the cut or channel the aim must be to get the best results at minimum cost and the final design will generally be a compromise between efficiency and cost.

The operation of the plant must also be considered and the possibility of securing good pondage above the site capable of carrying the daily load peaks will greatly enhance the value of a site and may

be the deciding factor in selection.

Where severe ice-conditions are to be anticipated as is usually the case in Canada, the possibility of eliminating or disposal of frazil ice must be considered.

If the velocity of flow can be reduced to about 3 feet per second ice-cover will form and the formation of frazil ice will be prevented. If the conditions are such that reaches exist where the velocity cannot be so reduced frazil ice will form in severe weather and the problem of its disposal must be considered.

In short, the development of power along a river entails a complete readjustment of its natural regimen and in addition to the selection of sites and design of structures a complete study of the hydraulics of the whole river must be carried out so that its behaviour under the changed conditions may be accurately forecasted.

Storage of Flood Waters

The foregoing has dealt principally with power sites and development. Almost invariably the possibility of storing flood waters to augment low flow is of equal importance and the prospective reservoir must be examined in the field to determine the possibility of erecting a storage dam and the volume of storage that can be secured. A careful study of the flow past this reservoir site —the reservoir may be a natural lake or a valley or depression which can be made into a lake—must be made so that the quantity of water available for storage and the most efficient way of drawing from storage worked out. The regulation of flow by storage is another feature which must be dealt with in studying the hydraulics of the whole river.

The foregoing indicates what is involved in a complete study of an important river. The complete work may be spread over such time as the exigencies of the case demand. Hydrometric work may be begun many years before the power survey is undertaken and the hydraulic studies may be postponed until the actual development of power is imminent.

Contents of Reports

The work as it progresses is collated into a report or reports which are prepared under the general headings as laid down in Water Resources Paper No. 10 already referred to, namely:—

I. *Sources of data.* Under this heading the reason and scope of the investigation are stated, the route followed and time consumed, and mention is made of all maps, records, reports, etc. used in the compilation.

II. *Summary of Report.* This is a brief summing-up of the water power and storage possibilities of the river investigated and of all the main features affecting its value as a source of power.

III. *General Introductory.* This comprises a general description of the river and watershed as a whole its topography and geology, and forms a background for a general understanding of what follows.

IV. *Water Supply.* Under this heading a complete analysis is made

of all information secured affecting the supply of water, size and nature of drainage area, actual measurements and all available records of flow and estimates, if possible, of maximum, minimum and mean flow. Meteorological conditions and records, storage reservoirs, either in existence or capable of creation. Prior water rights above and below various sites and effect of any works on natural drainage. Ice conditions under natural conditions and probable effects of any power or storage works created.

V. *Description of any existing power or storage developments.*

VI. *Detailed work at each Site investigated.* This covers the scope of work, accessibility, plans and profiles, foundation conditions, flooding and pondage, existing interest.

VII. *Possible Power Developed.* This describes the minimum power available, the quantity for six months of the year, the effect of storage or pondage for carrying peak loads.

VIII. *Estimates.* Where these are required approximate estimates are made of the capital cost of developing power and the consequent annual cost, also of the cost of any available storage.

IX. *Market for Power.* This deals with the present market, the future market, and the cost of transmitting power to markets within feasible transmission distance.

X. *Suggestions and Recommendations.* Here the engineer is expected to outline his best judgment, reached as a result of his studies and examination, concerning the possibilities of the site, how they can be best utilized and any further detail surveys which may, in his judgment, be necessary before deciding final action.

XI. *Appendices.* In the appendices are collected all plans, photographs, records, reports, maps, etc., which are pertinent to the subject matter of the report. Their inclusion serves to make the report a complete document concerning the river or site in question.

The above form the general outline of all reports; where the reconnaissance is made rapidly, some of the details are not available and have to be omitted, but in the case of a careful survey of an important river, such for instance as the Winnipeg river, all the above features are included.

This work when completed forms the technical basis of administration and also serves very materially to promote development in that interests desiring power can obtain, without either delay or cost, information that will quickly narrow down their search to two or three generally suitable sites. Further field examination is not the province of government engineers, the developing interest now takes charge and having, with the advice of its own engineers, selected the site desired, it must proceed with the close detailed surveys necessary to design the proposed works in detail, figure accurately the quantities and costs and secure such additional detail information as may be necessary to the preparation of working plans.

While the interests developing power carry out the actual construction it is necessary for them to submit their plans and specifications

for approval. Such approval is only accorded after the Government engineers are satisfied that the works will be stable and will conform to the general scheme laid down for the river as a whole. It is further necessary for the works to be under Government inspection while under construction so that there can be no question that they are erected in conformity with the plans and that the materials and workmanship do not transgress the approved specifications.

Annual Report of Dominion Water Power and Reclamation Service

The Dominion Water Power and Reclamation Service of the Department of the Interior of Canada has recently issued the annual review of its activities for the fiscal year ending March 31, 1924. During the period covered by this review the Dominion Water Power Branch and the Reclamation Service were amalgamated, and the annual reports formerly issued by each organization are now combined in one report, which describes the various administrative responsibilities of the combined services under three main divisions of activity, namely,—Water Power, Irrigation and Drainage.

The report just published (135 pages with 18 plates and 7 tables) describes under the section on Water Power the administrative and investigatory responsibilities involved; the method of co-operation with the provincial authorities in the conduct of the Dominion Hydrometric Survey, and the scope of this work during the period under review; the available and developed water-power in Canada as at February 1, 1924; the use of water-power in the mining, pulp and paper and central electric station industries in Canada; and the utilization of water-power in Canada in relation to coal production, importation and consumption.

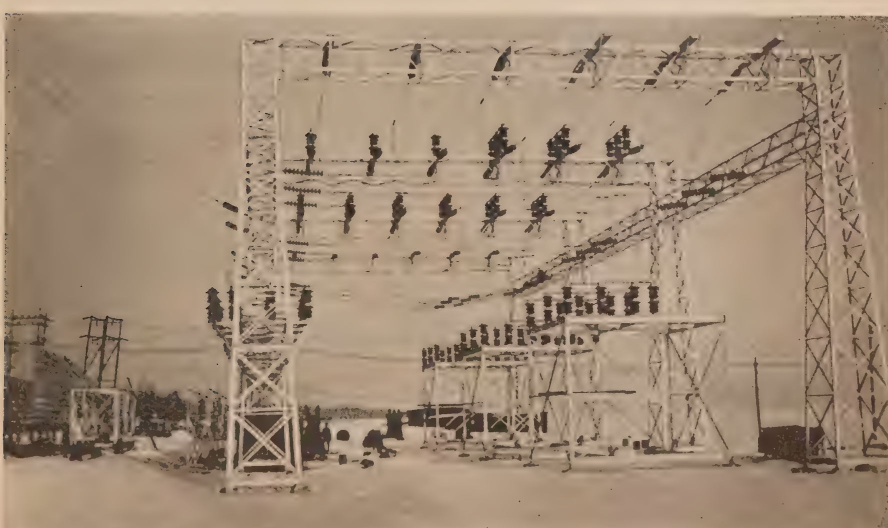
The Reclamation section of the report describes the surveys and inspections made for irrigation, domestic water supply, and drainage purposes during the year under review; the irrigation undertakings in operation, under construction or projected which are under the supervision of the department; the drainage schemes constructed or investigated by the Dominion; and research work in connection with the duty of water for irrigation, alkaline and other soils, rotation of crops and climatology.

Copies of this report will be supplied free of charge on application to the Director of Water Power and Reclamation, Ottawa, Canada.

O.M.E.A Summer Convention. A.M.E.U.
At Niagara Falls, Ont., June 24 and 25, 1925

Interior of Queenston power house looking North as it appeared April 11, 1925.

A recent picture of the Queenston power house.



Port Arther Transformer station at Bare Point, construction showing 110 kv. structure and busses.

Measurement of Natural Light During the Solar Eclipse of January 24, 1925

By G. G. Cousins, Illumination Laboratory, Hydro Electric Power Company of Ontario

THE total eclipse of the sun on January 24, possibly the most extraordinary event in the lives of most people, has passed into history and is practically forgotten.

A total eclipse furnishes an opportunity for the scientist to secure information that can be obtained in no other way. Consequently, expeditions and parties of observers are organized for observations and tests of many kinds during such an unusual phenomenon. For the first time in history an extensive organized attempt was made to obtain measurements of the natural light conditions before, during and after a total eclipse.

Mr. Preston S. Millar, General Manager of the Electrical Testing Laboratories, acting upon the request of President Crittenden of the Illuminating Engineering Society, was instrumental in the organization of nine expeditions at various locations along the path of totality to make the necessary measurements. Five other independent parties later added their results to those obtained under Illuminating Engineering Society auspices so as to make a more comprehensive collection of data and information.

Each party consisted of a supervisor, time-keeper, photometric observers, a recorder for each of the latter and recorders of general conditions.

The Toronto Chapter of the Illuminating Engineering Society was one of the first to respond with an organized expedition with a personnel as follows:

Professor G. R. Anderson, University of Toronto, in charge.

W. H. Woods, Toronto Hydro-Electric System, measurement of horizontal illumination.

K. B. Jackson, University of Toronto, measurement of sun corona.

Geo. G. Cousins, Hydro-Electric Power Commission Laboratories, measurement of sky brightness.

W. McGregor, Edison Lamp Works' A. G. Plumpton, H.E. P.C. Laboratories; W. Sangster, University of Toronto; Recorders.

Daylight is considered to be made up of two components, the direct light from the sun and the reflected light from the sky, and during total eclipse of the sun a third one enters upon the scene,—the light from the sun's corona. The plans provided for the measurement of each of these quantities separately. Each required a somewhat different method and arrangement of appar-

atus and since the nature of the problem precluded the use of laboratory methods, the work was done in the field with portable photometers.

From the start it was known that tremendous photometric difficulties would be encountered due to the great range in light intensities, which it would be required to measure, and to color difference between natural light and the comparatively yellow light of the comparison lamps of the photometers. Portable photometers for the measurement of illumination are rarely called upon for the measurement of intensity variations greater than the order of 200 to 1. The only advance information available regarding the intensity during totality was that the conditions were similar to full moonlight. Consequently the intensity range from before and after totality to totality would be of the order of 1,000,000 to 1. To overcome this extraordinary range sets of combined absorption and color filters were provided. Each set included seven filters, yellow ones to alter daylight to comparsion lamp color when daylight was high enough for their use and blue ones to alter comparison lamp color to daylight color when daylight was too low for the normal range of the photometer.

In all the expeditions 30 optical photometers, 1 photoelectric cell and 1 thermopile were used. All of the optical photometers required some modification or alteration to fit them for the problem in hand. The modifications consisting principally in providing for quick changes of filters and adding horizontal and vertical protractors where necessary.

The success of the undertaking depended very largely upon the preparation as it would obviously be impossible to check or repeat any questionable observations and the

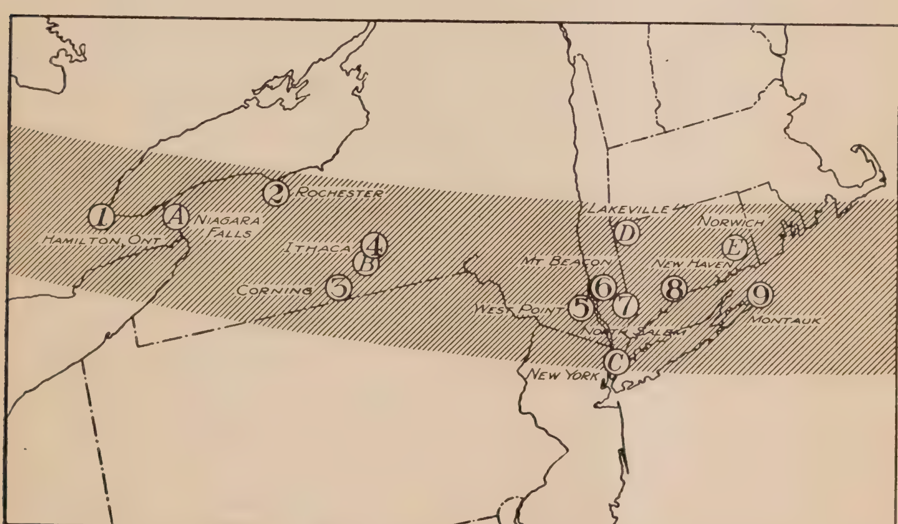


Fig. I. Locations at which Photometric Measurements of Natural Light were made during Solar Eclipse.

time during totality, the critical moment, was too short to permit of any adjustment other than the actual operation of the instruments. Consequently, the utmost care was necessary to provide for the smooth

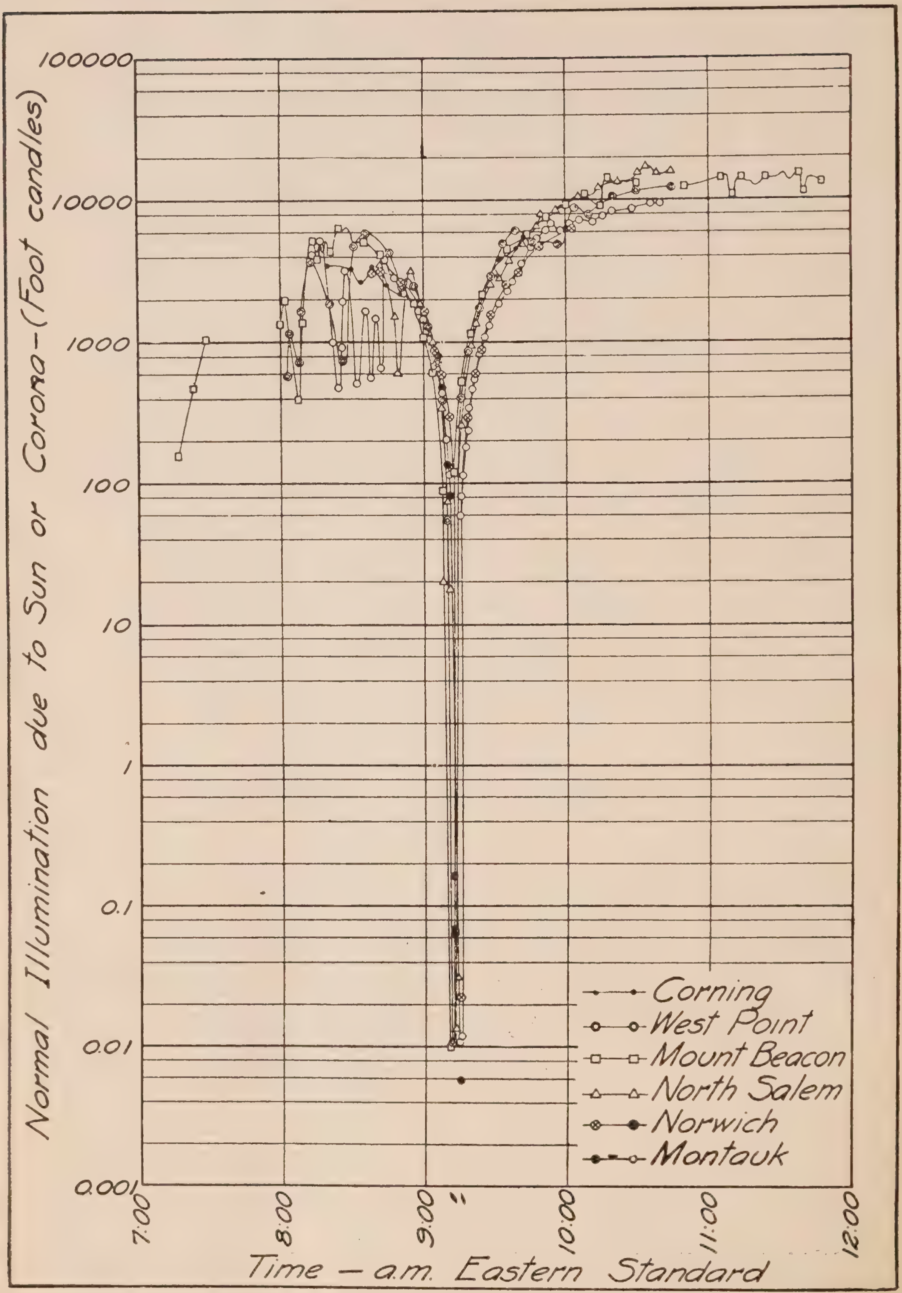


Fig. 2.

working of every detail of the apparatus.

The facilities of the Illumination Laboratory of the Commission included all that was necessary for the adjustment and calibration of the instruments used by the Toronto party. On Thursday, January 22nd, the local party assembled at the laboratory with all the apparatus that was to be used, three photometers and the necessary electrical accessories. The instruments were carefully calibrated and adjusted. Following this a rehearsal was held on the roof of the laboratory, each individual conducting his own part of the programme, making measurements of the conditions of fading daylight (sun corona excepted) which were continued until complete darkness had set in. By means of this each one was enabled to try out his own equipment and to become familiar with the range of illumination covered by the various filters and the conditions governing their use.

The Toronto party gladly accepted an invitation from Professor Chant to join the astronomical expedition at Long's Corners. Some members of the party went to Long's Corners on Friday, selected a suitable location for the work, set up the instruments and had a thorough tryout in the evening. On Saturday morning, all instruments were ready for measurements shortly after 7.00 and measurements were started about 7.45 and continued until about 9.30.

Although the sun rose into clear sky, it soon disappeared behind heavy clouds and it was obvious that no measurements of corona light would be possible. Consequently, Mr. Jackson changed over to the measurement of total illumination.

The Rochester and Toronto (at Hamilton) expeditions were the only ones so unfortunate as to fail to have a clear exposure to the total eclipse. All the others encountered clear sky around the sun at the critical time although the sky was speckled with light clouds at other times and at other parts of the sky.

Fig. 1 shows the location of the various expeditions along the path of totality.

All of the parties encountered very cold weather and most of them, high wind in addition. Instruments of the types used are very difficult to manipulate with gloved hands and the combination of low temperature and high wind would render bare fingers useless in a very few minutes due to their becoming benumbed. Consequently every adjustment, observation, manipulation and record had to be made under a very severe handicap. Some of the parties encountered trouble due to eyepieces of the instruments frosting and with some others adjustments of the instruments jammed due to low temperature.

Owing to the weather conditions low temperature, wind and clouds a high degree of precision cannot be expected. A cloud may obscure the sun at one moment, causing a low reading of intensity, and a moment later may reflect sunlight and cause a high reading. Allowing for all these uncontrollable variables a very fair agreement was secured among most of the results secured.

Fig. 2 shows the plotted results of the sun corona measurements. An average value of 0.013 foot candles may reasonably be assigned as the intensity due to the corona during the total eclipse. Measure-

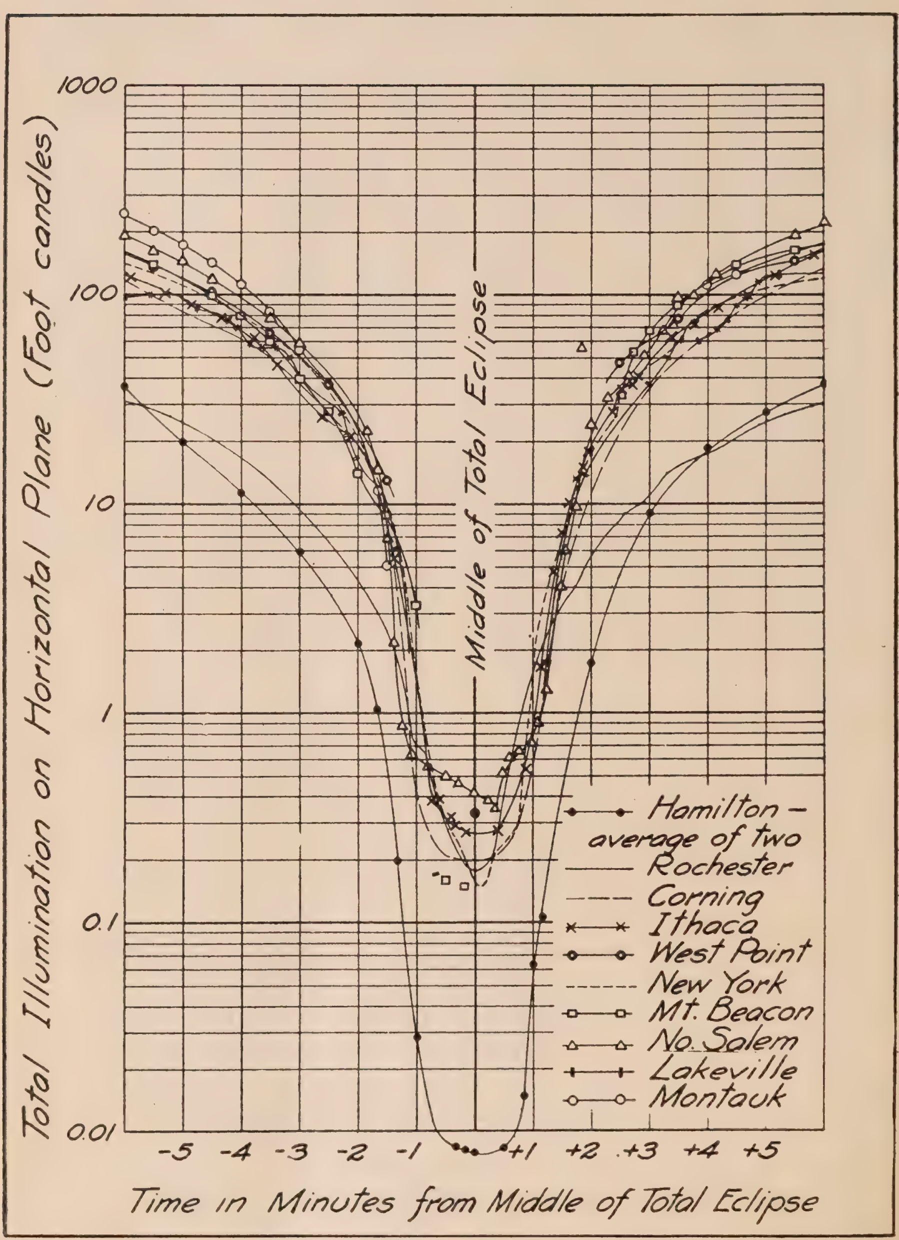


Fig. 3.

Fig. 4

1. *Party on top of Mount Beacon.*
2. *The Rochester party.*
3. *A photometrist and recorder of the Montauk party. Masks were worn to protect the faces from the bitter wind that was blowtng.*
4. *Toronto party at Hamilton, flashlight taken during the tryout on Friday evening. Two photometers at the right were connected to a recording chronograph, providing an automatic time record for each measurement.*
5. *The Boston party near Norwich, Connecticut.*

Fig. 5.

The edge of the band of totality across Manhattan Island, determined by observers. The shadow was superimposed upon the photograph by photographic means.

ments of full moonlight made during the following full moon showed that the corona intensity was about 0.845 of the full moon intensity.

Measurements of sky brightness were included in the programme in order to determine as well as possible the proportion of daylight that is due to sunlight reflected from the sky. For this purpose locations of the sky were selected at different altitudes and azimuths from the sun so that the horizontal illumination could be calculated from the brightness values at these points.

Fig. 3 shows the results of total illumination on a horizontal plane plotted for a time period of 6 minutes before and after totality. The effect of the heavy overcast sky at Hamilton (measured by the Toronto expedition) is quite apparent. Before the period of totality was reached flash lamps were called into use for reading the instrument scales, it being impossible to read the time from a watch by natural light. For the value of illumination on a horizontal plane during totality 0.25 foot candle has been assigned, this value applies to those locations where the eclipse was exposed.

The values given as test results are tentative and may be revised after a more detailed study of the records.

In spite of the very severe conditions under which the Toronto party worked its members were gratified by the smooth working of all the

Fig. 6.

Photometer set up for measuring the brightness of the sky

equipment from start to finish. Except for Professor Anderson's watch stopping when he laid it on a box nothing occurred to mar the carrying out of the programme insofar as the apparatus was concerned.

The color filters used were furnished by the Electrical Testing Laboratories.

The writer is indebted to Mr. P. S. Millar for data and some of the illustrations used in this article.

Electricity to the Rescue

SPRING work is beginning and summer work looms ahead and on past that again we can see winter with long hours of darkness when we grow discouraged because our plans for winter reading and sewing are frustrated by lamplight that will grow dim. Is there no good fairy to break the circle and start us on a new and easier and lighter path?

Indeed there is. "The Farmer's Advocate" has been out on the trail of that good fairy and has found that wherever electricity has come to the home, it has made all the difference possible. "We would not want to stay on the farm if we had to do without it now," says the busy women, as they tell the story of just how electricity helps them.

"What is the very best service it gives, the one thing that makes the most difference?" we asked, thinking of washers and stoves.

"Light," was the unanimous reply. "No lamps to clean and fill, in the first place, but most of all, no dim twilight hours when we want to work or read. The children have a good light to study by, and we don't have our hearts in our mouths for fear they tip over a lamp some day when their play gets exciting. We have light, real light, for as many hours of the day as we want to use it. And we don't have to carry a lamp every time we go down cellar!"

Yes, there is a charm about those buttons on the wall which will at a touch flood the room with light and even send light ahead to the cellar or upstairs so that no one need ever make perilous journeys in the dark. But our servant, electricity, having lighted our home, proceeds to simplify all the work. Here in the kitchen is the spotless stove. One of the first things one notices is that when a stove is more like a table than a box, there are no dark and dusty corners underneath and behind to cause work and defy the broom. A stove with four "burners" and a capacious oven seems the favorite size and proves equal to all the needs of the farm kitchen, indeed, the housewives find that they rarely use the whole stove.

"Just what is there about this stove so much better than the old range?"

Chiefly, it would seem, the placid good-nature of the thing, which will

permit a busy woman to do her work upstairs or outdoors with a mind at peace knowing that she won't need to run to the kitchen every little while to put a stick in the stove, or to see if anything is burning. So a mind at rest from these petty daily worries seems the great boon confirmed by the efficient stove. But it has many other virtues. A little slower, perhaps, but that only means starting things just a bit sooner. Once started they cook at an even temperature, according to the heat one has allowed, high, low, or medium. Food may cook at all the different temperatures at the same time on the same stove. Oven cooking is especially good, and with these ovens, which are so wonderfully insulated and hold their heat so long, many things may be simply left to cook with all the heat turned off so that there is no danger that they will burn. Some housekeepers find a slight disadvantage in the absence of the hot-water tank to which they had grown accustomed before electricity came to the house. But on one busy dairy farm where endless hot water is needed for washing bottles and other equipment, they heat this water on the electric stove all summer and still the monthly cost was not over seven dollars, though in addition to the hot water, all the meals had been cooked by electricity, with two big bakings weekly;the washing machine, lights and other appliances all doing duty. They seemed to think it well worth the money, though a quarterly bill for $50.00 (including service charges) had looked big the first time it came in. In the same household in winter-time, when a stove is used for heating and at the same time takes care of the supply of hot water, the electric cost was about $2.00 monthly.

The washing machine speaks for itself, with a big wash completed in two hours. Speedy work because the machine runs itself once started, and while it is taking care of one lot, the women can leave it to itself while they sort and shake and hang out other lots. It is an efficient, labor-saving, excellent household assistant.

After washing comes the ironing, and the electric iron has a place all its own in the hearts of the busy women. They remember the days when they rushed through their work no matter how hot or how tired they might be, so that they could take advantage of a big fire to get the ironing done. Baking and ironing were often run together, so that there need not be another big fire just to heat irons. Now there is no need to do ironing at any special time. It can be done in installments, or left till the cool of the evening, or otherwise fitted into the day at the convenience of the housewife. No wonder women think the iron one of the great boons of an electric age.

And most houses where there is electricity at all just naturally include a toaster in the equipment. We must be fond of toast, for we all want a toaster as soon as the house is wired. And while few have vacuum cleaners, yet all are planning to have them.

The houses along the road we travelled were using Hydro power,

and they had some very nice things to say of the Ontario service. Not that they think it faultless. The service charge is counted a bit high, from the point of view of those who pay the bills, but they all agree that doubtless it is as reasonable as possible, and they look forward to the day when more and more will use the service and so cut down the cost of all.

As for the actual cost, it is reckoned well worth the money. Here is a house with light, stove, washer, iron and toaster, the total cost running to about $100.00 a year. One woman does the work alone and the house is spotless. If it were not for her good fairy travelling up the lane on those wires she would need to hire help for at least part of the year, and the cost would be a good deal more than $100.00. And, of course, she might not be able to find help, in which case she would do her best at the cost of her own health and strength. How many women have done that—with a bill in the end that ran to many dollars, though dollars were the least part of the payment required!

It costs money in the first place to get the electricity into the house. Just how much it will cost depends a good deal on how many of the neighbors are sharing the service and how far one's house is from the road. That dairy farm set away back had a bill of nearly ninety dollars for the wiring up the lane. Had they chanced to build their house literally by the side of the road the bill would have been much less. Another farm along this road had to choose between buying a car and installing Hydro. They chose Hydro at a total cost of $200.00 less than the car they would have bought. They will have the car too one of these days, but in the meantime there is a busy woman well content and a family that knows they made the right choice.

The stove and the washer are the two big items on the household bill. Experience shows that the stove comes first with most women. As soon as they can afford to invest the money or can see their way clear to make regular payments on the installment plan, they want the stove. Once the first cost can be surmounted, there is no question of the efficiency of electricity for cooking. Women who have tried both tell us that the cost of operation is less than for coal oil stoves. Those who have wood lots and have been accustomed to getting their fuel without cost are the only ones who are out of pocket by using electricity. —*The Farmer's Advocate.*

Pepper and Salt

Sometimes I sit and wonder, discontent,
About the little place I fill in this great scheme of things—
An operator—nursemaid to a water-wheel—
Answering telephones—writing logs,
And ever listening to the endless roar
The generators make.
When I was young—Oh, well, you know how youngsters dream—
I was a mighty engineer; I'd build a bridge three miles across;
A project which would rival Muscle Shoals;

A railroad vast with no beginning
  and no end.
And now—it's time to read the
  meters once again
And write the log.
But sometimes when my shift is done
I climb the hill up by the dam
And look across the country that
  I've learned to love,
As God's own land,
And see a myriad specks of light—
Each light a home—each light kept
  burning
By my noisy wheels.
And then I understand, and almost
  feel content
To know I guard the light—I help
  to make these homes.
Of course I know they never think
  of me,
But if they did I know a thousand
  mothers' lips
Would frame a prayer, "God bless
  the men who guard the light."
At such a time I do not wonder,
  discontent,
About the place I fill in this great
  scheme of things.

—*Pacific Light & Power Co. Bulletin.*

Doctor Says Man Run By "Dry" Cells

Man has been likened to many things—at times. Darwin said that he was once a monkey. Some of us still are. Dr. Woods Hutchinson likened a man to an internal combustion engine, within whose mechanism the sugar taken into the system became, by chemical processes, alcohol.

Now comes science again to the fore. Another doctor, this time a surgeon, Dr. George W. Crile of Cleveland, smashes the quite appealing distillery idea advanced by Dr. Hutchinson and offers a substitute—a quite unsatisfactory one—the idea that man is operated electro-chemically and that he, marvelous to relate, is made up of some 28,000,000,000,000 "electric cells"—dry batteries, perhaps.

The human emotions—love, hate, fear, and the others—according to the learned doctor, are merely stimuli, liberating currents of electrical energy to roam around within us in certain defined paths. Each of the twenty-eight odds and ends of trillions of cells—dry batteries—no, "wet" batteries, says the doctor, have positive and negative poles, without which we will agree no battery, wet or dry, is complete. Of these, the brain cells, it seems, are the most positive, while those of the liver are the most negative.

Here, then, is what has been the matter with our liver all this time. Avaunt, calomel and nasty-tasting nostrums. Let us short our recalcitrant livers, or ground them, or insulate them against the high-voltage indigestion germs found in rich food. Here is an opportunity for a real combination, by which these electrical emanations may be harnessed, synchronized and a new type of central station developed, and the ultimate consumer protected from the vagaries of rainfall and the price of oil.—*Journal of Electricity.*

Hydro News Items

Central Ontario System

Extensive changes are being made in the L. T. switching arrangements in the Osawha substation and additional feeder panels are being installed to take care of Oshawa's growing industrial load. The outside work involves bringing all the L. T. feeders underground below the C.N. R. tracks to an outside distribution tower. The work is proceeding satisfactorily.

* * * *

A line is being built at Bowmanville to serve the large training school established by the Ontario Government outside the town. The Rotary Club is taking particular interest in the establishment of this school.

* * * *

The Roy-Wolfe Brewing Co. at Belleville have made a contract with this Commission for the supply of 150 h.p.

* * * *

Niagara System

The Hamilton Commission is preparing plans for a new substation at Hughson Street. The present station at Hughson Street is inadequate to take care of the increase in load, and a new building with modern equipment is necessary. Plans are also being prepared for a new garage to handle the transportation equipment belonging to the System.

* * * *

The Windsor Hydro-Electric System is making arrangements for the installation of an additional transformer in the new substation. The new transformer will be three phase, 5000 kv-a. At the present time the substation is equipped with the following three phase transformers—

3—1500 kv-a
3—3000 "
1—5000 "

Approximately ten years ago the Windsor substation was equipped with 750 kv-a three phase transformers, but the rapidly growing load has necessitated the use of larger units.

* * * *

The Hydro-Electric Power Commission of Ontario has recently opened an office in Dundas to be used as a field office for the operation of the Dundas Rural Power District.

* * * *

East York Township, which was formerly part of York Township, is arranging to take over the operation of the light and power distribution system in the Township. This System has up to the present time been operated for the Township by

the Toronto Hydro-Electric System. The separation from the Toronto System will take place as of June 1st, 1925.

List of Electrical Material, Devices and Fittings

Approved by the Hydro-Electric Power Commission of Ontario in April, 1925.

Appliances

BEATTY BROS. LIMITED, Fergus, Ont.

Electric Washing Machine, "Cataract".

* * * *

THE NATIONAL ELECTRIC HEATING CO., LTD., 544 Queen St. E., Toronto.

Electric Soldering Iron.

Electric Curling Iron.

* * * *

THE CANADIAN FAIRBANKS-MORSE CO., LTD., 26 Front St. W., Toronto.

"Fairbanks-Morse" Motor-operated Shallow Well Water Systems, Style Nos. 6501 to 6505 incl., 4237 to 4239 incl., 4245 to 4247 incl.

* * * *

THE LELAND ELECTRIC CO., Dayton, Ohio.

"Leland" Motors.

* * * *

J. H. CONNOR AND SON, LTD., 22 Lloyd St., Ottawa, Ont.

Electric Washing Machines, "Good Housekeeper" and "Economy".

* * * *

REED AND CAMERON, 188 Adelaide St. W., Toronto.

Electric Table Stove, Type A.

* * * *

THERMO ELECTRIC, LIMITED, Brantford, Ont.

"Thermo" Tubular Element, Type B, Electric Water Heaters.

Single Unit Immersion Heaters, Cat. Nos. 51, 52, 61, 62, 71, 72, 110, 120, 210, 220, 310, 320, 420, 520.

Twin Unit Immersion Heaters, Cat. Nos. 752 and 1020 respectively.

Twin Unit Circulation Heaters, Cat. Nos. 1102, 1202, 2102, 2202, 3102, 3202, 4202, 5202, 7502 and 10,202.

* * * *

MESSERVEY'S INDUSTRIES, INC., 257 Washington St., Buffalo, N. Y.

Christmas Tree Lighting Sets, Cord No. 1, Cord No. 2.

* * * *

*IVES MANUFACTURING CORP., THE, Bridgeport, Conn.

Toy Transformers, Cat. No. 204.

* * * *

*UNIVERSAL ELECTRIC STAGE LIGHTING CO., 321 W. 50th St., New York, N. Y.

Lamps—Arc, Type D.C., "Kliegl".

* * * *

*DELCO-LIGHT CO., Dayton, O.

Electric Lighting Plants (As listed on Underwriters' Laboratories card dated June 29, 1922).

* * * *

*GIBB INSTRUMENT CO., Bay City, Mich.

Gibb Welding Machines Co. (Submittor), Bay City, Mich.

Electric Welding Machines. Trade Name, "Zeus".

* * * *

*Clarinda Mfg. Co., Clarinda, Iowa.

Electric Washing Machine, "Clarinda".

* * * *

Fixtures

S. Robert Schwartz & Bro. 546 Broadway, New York, N. Y.

Portable Electric Lamps.

* * * *

The Crown Electrical Mfg. Co. Limited, Brantford, Ont.

Portable Electric Lamps, "Crown"

* * * *

Carl Austin & Co., 266 King St. W., Toronto.

Portable Electric Lamps.

* * * *

*Shinn Mfg. Co., W. C., 154 Whiting St., Chicago, Ill.

Lightning Arrester, Type S.1.

* * * *

Fittings

Benjamin Electric Mfg. Co. of Canada, Ltd., Toronto.

Medium Base Receptacles, Cat. No. 86608, 88223.

Medium Base Sockets, Cat. Nos. 79480, 79481.

* * * *

Smith and Stone Limited, Georgetown, Ont.

Medium Base Receptacles, "S. & S."

For outlet box Cat. No. 1353. Sign Receptacle, Cat. No. 1113.

"S-S." Porcelain Cleats; Porcelain Tubes and Bushings.

* * * *

*Beaver Machine & Tool Co., Inc., Newark, N.J.

"Beaver" Current Tap, Cat. No. B.4.

* * * *

*Universal Electric Stage Lighting Co., 321 W. 50th St. New York, N. Y.

Receptacles for Attachment Plugs and Plugs (As listed on Underwriters' Laboratories card dated November 17, 1922).

* * * *

Miscellaneous

*Beaver Machine & Tool Co., Inc., Newark, N.J.

Cord Sets, Cat. Nos. K-1, K-2 and K-3.

* * * *

*Northern Aluminum Co., Ltd. Sterling Rd., Toronto.

Rigid Aluminum Conduit.

* * * *

*These devices are under the Underwriters' Laboratories re-examination or label service.

Re. Municipal Populations

To enable The Bulletin to give as nearly as possible the correct populations of the Hydro Municipalities as shown in the lists on the inside of the cover, it would be of considerable assistance if the Municipal Officials advise of any corrections that should be made.

—Editor.

THE BULLETIN

Published by
HYDRO-ELECTRIC POWER COMMISSION
of Ontario

190 University Avenue
Toronto

Subscription Price $2.00
Per Year

Sir Adam Beck's Letter of Submittal of the Seventeenth Annual Report of the Hydro-Electric Power Commission of Ontario.

To His Honour THE HONOURABLE HARRY COCKSHUTT,
Lieutenant-Governor of Ontario

MAY IT PLEASE YOUR HONOUR:

The undersigned has the honour to present to your Honour the Seventeenth Annual Report of the Hydro-Electric Power Commission of Ontario for the fiscal year ending October 31, 1924.

This report covers all of the Commission's activities and also embodies the financial statements of the municipal electric ultilities operating in conjunction with the various systems of the Commission and supplying electrical service to the people of the Province. The financial statements, the statistical data, and the general information contained herein have been so arranged as to present clearly and concisely every important feature of the Commission's operations.

The Report deals with all phases of the operations of the Commission for the past year with respect to nine systems to which are connected 386 municipalities, including 131 townships and rural districts, and 93 industrial companies. The Report also shows the cumulative financial results for the various periods during which operation has been maintained.

Industrial conditions throughout the Province during the year have improved but are still below normal, with the result that there is not yet a rapidly increasing demand for power for industrial uses. Notwithstanding this general industrial condition, there has been a considerable growth in the demand for power on nearly all systems, and on several systems the Commission has reached the limit of the capacity of the existing generating plants. It is, therefore, necessary for the Commission, on practically all systems, to make arrangements to secure additional power developments to meet the ever-increasing demand.

During the past year, special efforts have again been made by the Provincial Government, by the municipal-

CONTENTS

Vol. XII. No. 6
JUNE, 1925

ities of the Province and by the Hydro-Electric Power Commission to secure permission to commence construction of the power development works in the international portion of the St. Lawrence river. Delay in securing the permission sought must result in accentuating the power shortage that is rapidly materializing.

A gratifying feature of the Commission's operations during the past year is the remarkable increase in the demand for electrical energy in the Thunder Bay system. Not only is this system in excellent financial condition, but the contracts for electrical energy are such that an aggregate of 70,000 horsepower is under agreement, while additional applications have been received from customers such as will bring the early possible future load to about 90,000 horsepower. This great demand has compelled the Commission not only to increase existing plants to their maximum capacity, but to determine also the means by which a large increase in power-producing installation may be provided in order to serve the rapidly growing needs of this important section of the Province.

The following tabulation (Table No. 1) shows the growth in load in the various systems during the year:

DISTRIBUTION OF POWER TO SYSTEMS

20-Minute Peak Horsepower

System	October 1923	October 1924	December 1924*
Niagara system and export	592,775	581,770	662,311
Georgian Bay system	13,695	15,449	15,529
Muskoka system	1,415	1,560	1,582
St. Lawrence system	5,877	4,998	5,112
Rideau system	3,137	2,694	2,607
Thunder Bay system	16,958	34,200	37,500
Ottawa system	12,528	13,206	14,708
Central Ontario and Trent system	37,332	34,892	39,222
Nipissing system	1,769	2,429	2,218
Total	685,486	691,198	780,789

*The December loads are also shown for 1924, as many varying factors make it difficult to show from the October conditions of 1924 the real growth of the systems' loads.

Table No. 1

It will be observed that the financial statements embodied in this Report are presented in two main divisions, namely, a division—Section IX—which deals with the operations of the Commission in the generation, transformation and transmission of electrical energy *to the co-operating municipalities*, and a division—Section X—which deals with the various operations of the municipalities in the localized distribution of electrical energy *to consumers*.

The cumulative results to date of the operation of the several systems of the Commission as set forth in this Report demonstrate a remarkably healthy financial condition.

The total investment of the Hydro-Electric Power Commission of Ontario in power undertakings and hydro-electric railways is $190,027,909.66, and the investment of the municipalities in distributing systems and other assets is $72,753,596.31, making, in power and hydro-electric railway undertakings, a total investment of $262,781,505.97.

The following statement (Table No. 2) shows the capital invested in the respective systems and municipal undertakings:

Niagara system	$148,469,979.78
Georgian Bay system	4,383,531.42
Muskoka system	387,314.97
St. Lawrence system	1,047,855.07
Rideau system	1,081,913.40
Thunder Bay system	9,336,535.13
Ottawa system	30,265.98
Central Ontario and Trent system	13,463,780.86
Nipissing system	1,012,252.20
Service buildings, construction plant, stores, etc	2,686,666.16
Hydro-electric railways	8,127,814.69
	$190,027,909.66
Municipalities' distributing systems and other assets—all systems	72,753,596.31
	$262,781,505.97

Table No. 2

It is gratifying to the Commission to be able once again to report that the revenue obtained from the consumers has been more than sufficient to meet the full cost of generating and transmitting the electrical energy as well as to provide for all operating expenses and the fixed charges of the municipal utility equipments.

The Commission collected from the municipal utilities and other customers, for power sold, a total sum of $16,897,866.73. This sum was appropriated to meet all the necessary fixed charges and to provide for the expenses of operation and administration. After meeting all charges there was left a net surplus of $725,708.55.

The following statement (Table No. 3) summarizes the Commission's collections from municipal hydro-electric utilities and other power customers for the year and shows how the collections have been appropriated:

The following (Table No. 4) is a summary of the year's operation of the municipalities which operate under cost contracts with th eCommission:

The above covers only the municipalities operating under cost contracts with the Commission.

Revenue from municipalities and other power customers....		$16,897,866.73
Appropriated as follows:		
Operation, maintenance, administration, interest and other current expenses....	$13,078,003.14	
Reserved for sinking fund, renewal of plant and equipment, and contingencies	3,094,155.04	
		16,172,158.18
Net surplus after providing for all operating expenses and necessary fixed charges..		$725,708.55

Table No. 3

Total revenue collected by the municipalities..............		$18,798,723.43
Cost of power	$9,669,789.40	
Operation, maintenance and administration..	4,088,584.18	
Debenture charges and interest............	2,902,790.13	
Depreciation..........................	973,649.62	
Total....................................		17,634,813.33
Surplus for the year............................		$1,163,910.10

Table No. 4

The total reserves of the Commission and the municipalities for sinking fund, renewals, contingency and insurance purposes amount to $39,040,538.32, made up as follows:

Niagara system	$11,019,998.43
Georgian Bay system	787,198.72
Muskoka system	42,282.12
St. Lawrence system	206,470.96
Rideau system	83,946.47
Thunder Bay system	52,560.09
Ottawa system	3,320.67
Central Ontario and Trent system	1,616,729.25
Nipissing system	82,047.07
Service buildings, etc	878,007.37
Total reserves on Commission's property	$14,772,561.15
Total reserves of municipalities	24,267,977.17
Total Commission and municipal reserves	$39,040,538.32

The consolidated balance sheet of the municipal hydro-electric utilities, on page 309, shows a total cash balance of $1,748,912.34 and bonds and other investments of $1,329,622.58, being an increase of $648,970.39 over the corresponding assets for 1923. The total surplus in the municipal books now amounts to $16,170,142.49 and this is in addition to the depreciation reserve of $8,097,834.68.

The following is a brief summary of the principal operations which are presented in greater detail in the body of this Report:

Niagara System

The Niagara system embraces all the territory lying between Niagara Falls, Hamilton and Toronto on the east, and Windsor, Sarnia and Goderich on the west, as served with electrical energy generated at Niagara Falls.

In this system, the Commission has a total capital invested of $148,469,979.78 and accumulated reserves of $11,019,998.43.

The actual cost of power was $175,710.32 less than the amount of the estimate upon which the interim rates were based. The municipalities show a net surplus from the year's operation of $774,466.04 after providing depreciation to the extent of $825,845.55. Only one municipality shows an actual deficit during the year, of $84.25, and this out of a total revenue of $15,964,746.80. There has been a gradual increase in the number of customers and in the loads supplied to the municipalities.

The sixth unit of the Queenston-Chippawa plant was put into oper-

ation early in the year, and all six units are now operating at full capacity. The seventh generator is being installed and will be put into operation early in November, 1925. Contracts for unit No. 8 have been placed and the work of installing this unit is well under way. The Queenston generating plant, the Electrical Development Company generating plant and the Ontario Power Company generating plant, all of which heretofore have been operated as separate units, were this year for the first time combined, both as regards investments and operation. The average cost of generated power at which the municipalities were billed during the year included all operating charges and all fixed charges on the three plants, including, for the first time, full sinking fund and depreciation on the Queenston-Chippawa plant.

Georgian Bay System

At the beginning of this year the Severn, Eugenia and Wasdells systems were combined and for the first time appear in this Report as a unit known as the Georgian Bay system, the year 1924 constituting the year of initial operation of this amalgamation. These three systems since 1916 have been interconnected by means of transmission lines and have been interchanging power, but experience has proven the necessity of combining these various systems into a single system in order to secure greater economy in administration and, at the same time, to eliminate the complications involved under separate operation. The results of the first year have demonstrated the advantages of such an arrangement.

As now constituted, the Georgian Bay system consists of fifty-two urban municipalities and thirteen rural power districts, including the supplying of energy to four companies. The combined system serves that portion of the Province of Ontario which surrounds the southern end of Georgian Bay and lies to the north of the territory served by the Niagara system. It includes also the district surrounding Lake Simcoe. The generating output of the three hydro-electric plants at Eugenia Falls, Big Chute and Wasdells Falls, together with the capacity of the frequency changer station at Mount Forest through which approximately 1,000 horsepower is obtained from the Niagara system, exceeds 15,000 horsepower and the average load sold during the year was 15,690 horsepower. These figures clearly indicate the fact that the various generating stations of this system are fully loaded. During the year, arrangements were completed for additional generating capacity obtainable at the South Falls development of the Mus oka system. At the beginning of the next fiscal year, the Muskoka system will be included in the Georgian Bay system. The Commission has a total capital investment in this system of $4,383,531.42, and accumulated reserves for renewals, sinking fund and contingencies aggregate $787,198.72.

The actual cost of power during

the year was $74,211.78 less than the estimates on which the interim rates were based, and the municipalities, after providing for depreciation of $37,342.35, operated with a net surplus of $109,442.56. Five municipalities operated with a small loss, aggregating $1,205.50.

Muskoka System

The Muskoka system is supplied from a hydro-electric power development at South Falls on the Muskoka river and serves the municipalities of Huntsville and Gravenhurst. The Commission has in this system a total capital investment of $387,-314.97, and accumulated reserves aggregate $42,282.12.

The actual cost of power during the year was $294.32 less than the estimates on which the interim rates were based and the municipalities, after providing full depreciation, operated with a net surplus of $5,116.94.

As the installed equipment of this development was approximately 1,500 horsepower and as the potentiality of the Muskoka river at this situation—including the power sites at South Falls and at Hanna Chutes about a mile farther upstream—was capable of being developed to approximately 7,000 horsepower, arrangements were completed for increasing the development on this river. The plans involved the removal of one of the small units and the installation of two new units of 2,200 horsepower each at the South Falls site—known as generating station No. 1—and one unit at Hanna Chutes of 1,550 horsepower—known as generating station No. 2. Construction work covering these improvements has been progressing throughout the year and it is expected that two of the new units will be in operation and under load during the early part of next year; the Hanna Chutes unit will probably be ready for operation about the first of 1926.

St. Lawrence System

The St. Lawrence system serves the district immediately to the north of the St. Lawrence river between Brockville and Cornwall; the supply of power for the system being purchased from the Cedar Rapids Transmission Company, delivery being made from a point near Cornwall. Service is given to ten municipalities, six rural power districts and three companies.

The Commission in this system has a total capital investment of $1,047,855.07 and accumulated reserves for renewals, sinking funds and contingencies aggregate $206,-470.96. In the interim bills the Commission collected $15,040.93 in excess of the cost of operating the system. The municipalities, after providing for full depreciation, ended the year with a net surplus of $40,825.70. Three municipalities had a loss of $1,587.31 in the year's operations.

A company taking about 1,500 horsepower ceased operations and was disconnected from the system in March, 1924. Due to the loss of this load, the demand on the system was reduced, and on this

account the average power sold during the year was somewhat less than during the preceding year.

Rideau System

The Rideau system serves the district in the vicinity of Smiths Falls, Perth and Carleton Place. Power is available from two generating plants, one at Carleton Place and the other installed by the Commission at High Falls. Both are situated on the Mississippi river. The Commission also purchases power from the Rideau Power Company of Merrickville. The Carleton Place plant was not in operation during the past year because the capacity of this plant was not required in order to provide the power requirements of the municipalities. The system supplied five municipalities situated between the Ottawa and St. Lawrence rivers, west of Ottawa.

The water supply for this system, which is augumented by storage development on the Mississippi river, was adequate and thus the Commission avoided the necessity of operating any steam equipment to supplement the hydro-electric power supply available. The amount of power sold on the system was not materially increased over that sold in the previous year. The Commission, through the interim bills, collected from four municipalities $8,228.15 in excess of the amount necessary. In the case of the fifth municipality, an additional charge was made of $1,749.40. All of the municipalities finished the year with an aggregate net surplus of $17,701.16.

During this fiscal year this system commenced to pay sinking fund—one municipality having received a supply of power from the Commission for a period of five years.

Thunder Bay System

The Thunder Bay system, which serves the district at the head of the Great Lakes, including the twin cities of Port Arthur and Fort William, with power from the power development at Cameron Falls on the Nipigon river, has had a most successful year. The records of this system for the past fiscal year show a surplus of $52,560.09 after providing for all operating, maintenance and administrative charges, as well as providing for the full yearly interest on the entire operating capital. This surplus is applicable for contingency and renewal reserves. The total operating capital of this system for the current year is $9,336,535.13.

The load in the city of Port Arthur—the original customer of this system—which when the system was placed in operation four years ago, was less than 7,000 horsepower, reached a peak during the year of over 21,000 horsepower. The total average load sold on the entire system for the year was 27,254 horsepower and it is estimated that during the next fiscal year this will reach 40,000 horsepower.

During the year service was given for the first time to the Great Lakes Paper Company in Fort William. This company is now taking approximately 12,000 horsepower. During

the year service was also resumed to the Nipigon Pulp Mill, which is now taking approximately 3,000 horsepower. Arrangements were also made for giving service to Nipigon village through the substation at the Nipigon pulp mill.

To provide for these increased demands it has been necessary for the Commission to install additional units, and consequently units No. 3 and No. 4 have been installed and placed in operation during the year. Provision has been made for installing units No. 5 and No. 6, which should be completed and under load before the close of the next fiscal year. Arrangements have also been made for constructing a dam at Virgin Falls for the purpose of creating storage on lake Nipigon.

Central Ontario and Trent System

The Central Ontario and Trent system serves the district bordering the north shore of lake Ontario lying between the territory on the west served by the Niagara and Georgian Bay systems and that on the east served by the St. Lawrence and Rideau systems. The nucleus of this system was the group of properties formerly controlled by the Electric Power Company, Limited, and operated by it through the agency of twenty-two subsidiary companies. These properties were all purchased by the province of Ontario on March 1, 1916, and have been operated by the Commission as trustee for the Province since June 1, 1916. Since that date the system has been greatly enlarged and expanded in order to meet the constantly growing needs of the district.

Twelve municipalities, ten of which have been connected to the system since the date of purchase, operate their own distribution systems under contracts with the Commission. These municipalities are grouped in what is termed the Trent system. This system also includes certain rural power districts.

The power supply for the Central Ontario and Trent system is obtained from a number of power developments situated on the Trent and Otonabee rivers. The power developments are made in conjunction with dams required for navigation purposes. Two new developments are now under construction at Dams No. 8 and No. 9. The development at Dam No. 8 is practically completed and since September has carried load. Satisfactory progress has been made on the generating station at Dam No. 9 and, it is expected, this will be ready early in 1925. Both of these generating stations are of the automatic type and will be controlled from the power house at Ranney Falls—Dam No. 10.

Investigations on the possibilities of the Crow river storage basin for increasing the power supply on the Trent river were continued and a report is in preparation covering the power possibilities and economic features of storage in this basin.

The quiet commercial conditions reported in 1923 continued, and there were no outstanding increases in the power load supplied.

For the purpose of financial statements the Nipissing system, referred

to below, is included with the Central Ontario and Trent system. The financial results of the operations of the year are very satisfactory. After meeting all operating and maintenance costs, all interest, all sinking fund provision on that portion of the investment for which sinking fund provision is required, provision for renewals reserve of $138,527.44 and provision for contingencies reserve of $40,055.60, a net surplus of $132,945.48 was available. It is noteworthy that the total reserves which have been set up out of earnings for the benefit of these systems now amount to $1,646,947.72.

The municipalities constituting the Trent system are considered as customers of, and are supplied with electrical energy from, the Central Ontario and Trent system. The result of their combined operation for the year shows a net surplus of $85,029.07 after providing for $24,-991.40 depreciation. One municipality shows a loss of $756.44.

Nipissing System

The Nipissing system comprises the town of North Bay and certain small municipalities south of lake Nipissing. It was purchased by the Province with the Central Ontario system in 1916 and has since been operated by the Commission. It is supplied with power from two hydro-electric developments on the South river at Nipissing and Bingham Chute. The new development at Bingham Chute was completed and placed in operation for the first time during the year, thus making available for this system an additional 1,200 horsepower of generating plant.

* * * *

In conclusion, it may be emphasized that the past year has been the most successful in the Commission's history, and apart from the menace that exists on account of an approaching power shortage, the future of the Commission never appeared more promising. Attention is directed to a remarkable statement in the introduction to Section X, dealing with the Municipal Accounts, in which, at page 303, will be found a list showing that thirty-nine municipalities have now quick assets such as cash, bonds, accounts receivable and inventories which exceed in value the total liabilities incurred by these municipalities in connection with their municipal electric utilities. This is a very striking and most encouraging feature of the Commission's success. Twenty-four other municipalities have so nearly reached this status that it is probable that most of these also will be able to be entirely out of debt by the close of next year.

Respectfully submitted,

Adam Beck,

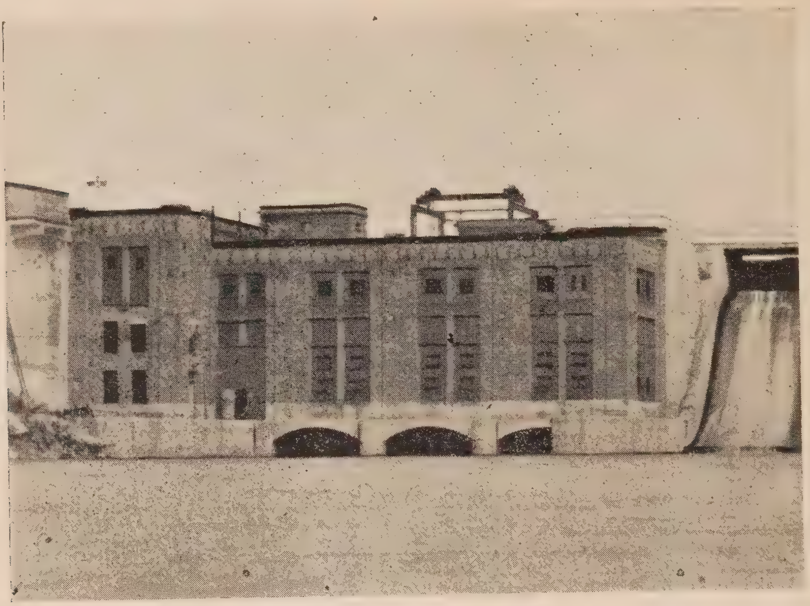
Chairman

South Falls Development and the Georgian Bay System.

THE completion of the extension of the South Falls development on the south branch of the Muskoka river now under construction, together with the amalgamation of the Muskoka, Wasdell, Severn and Eugenia systems into one general unit designated "The Georgian Bay System" marks a change in the Commission's policy necessitated by the growth in the demand for electrical energy which has taken place in that section of the province comprising the area covered by the four individual units indicated in the combine, including the district of Muskoka, the western portion of Victoria County and the counties of Ontario, Simcoe, Dufferin, Grey, Bruce and the northern portions of Wellington and Huron.

Before proceeding with a detailed description of changes at the South Falls development serving the original Muskoka system, it will be necessary to follow the progress of events in the expansion and growth of the various districts served by individual power plants which has required a treatment of the problems involved in the distribution of power on a much greater and more extended scale than has heretofore been possible in that section of the province adjacent to Georgian Bay and covered by the counties already mentioned.

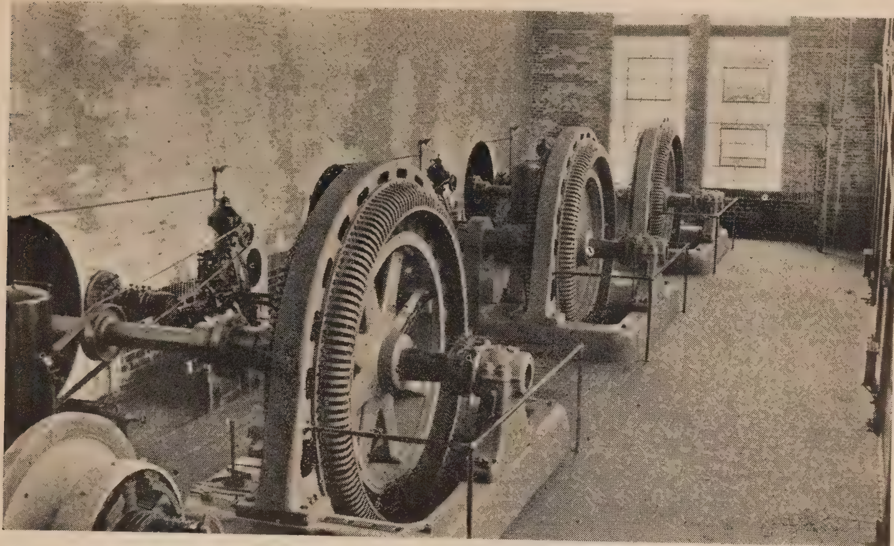
The development owned and operated by the Town of Orillia with its transmission lines and distribution system, although administered by a separate and independent Commission, nevertheless really forms a part of the Georgian Bay System, as the agreement between the Hydro-Electric Power Commission of Ontario and the Water & Light Commission of the Town of Orillia gives the Georgian Bay System first claim on all surplus power not utilized by the "Town" system and at the same time affords the means by which the Wasdell system is tied in with the other component parts of the combined unit thus enabling surplus power developed at Wasdell Falls to be utilized at other points on the system. Up to the present time, approximately one-half of the capacity of the Orillia generating station, varying from 2,000 to 3,000 h.p., has been supplied to the Georgian Bay System. The Orillia development at Ragged Rapids on the Severn River was the pioneer hydro-electric development in this district, having been constructed and placed in operation in 1890. The improvements in navigation on the Severn River and the inclusion of this stream in the Trent Valley Canal system required the drowning out of the Ragged Rapids site and the con-



Orillia Water, Light and Power Commission's Power House at Swift Rapids, Severn River.

struction of a new development at Swift Rapids some three or four miles further down stream. The Swift Rapids development has been in operation since 1916 and comprises three horizontal units, the turbines being rated at 2120 h.p. and the generators at 1500 kv-a. The generators are direct connected to the turbines and are 3-phase, 60 cycle, 2200 volts and operate at normal rating at 257 revs. per min. The normal operating head is 47 feet. The generated energy is stepped up to 22,000 volts and delivered partly to the Town of Orillia over its own transmission line 20 miles in length and partly to the Commission over the line between the Swift Rapids and the Big Chute development, this tie line having been constructed by the Town of Orillia at the time when the Big Chute Development was under construction by the Simcoe Railway & Power Company and was subsequently purchased by the Commission from the Town.

The Wasdell development located on the Severn River about three (3) miles below the foot of Lake Couchiching, possesses the unique distinction of being the first hydraulic development undertaken by the Commission; it was constructed in 1914 and operates under a 14 foot head and consists of two vertical direct connected units, the turbines being rated at 600 h.p., 90 revs. per min., the generators at 400 kv-a, 2,220 volts, 3-phase, 60 cycles the total plant capacity, based on nameplate rating of machines, being 800 kv-a or about 1100 h.p. This generating station serves the northern

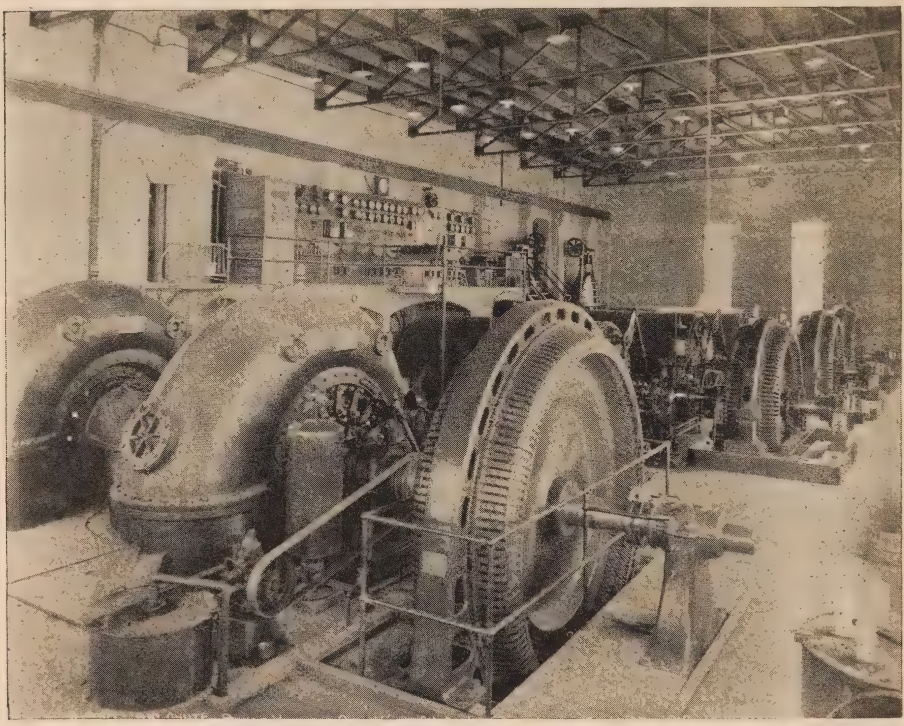


Swift Rapids Power House, Interior View.

portion of Ontario county and the western portion of Victoria county over a transmission line operating at 22,000 volts. The Wasdell development, together with its transmission lines is connected to the Big Chute development through the Orillia system, being tied into the latter at what is known as Longford Mills, which is located about eight miles from the development.

The Big Chute development, located on the Severn River about 9 miles up stream from the Georgian Bay, was originally constructed by the Simcoe Railway & Power Company in 1910 and 1911, for the purpose of serving the town of Midland and adjacent municipalities. From 1911 to 1914 the Commission purchased power from the company and transmitted and resold same to the towns of Penetanguishene, Midland, Coldwater, Barrie and Col-

Big Chute Power House.



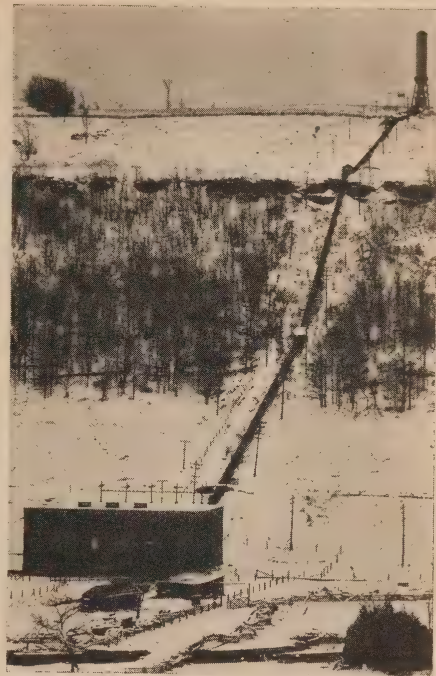
Big Chute Power House, Interior View

lingwood. As the demand in these towns was steadily increasing and as additional municipalities in Simcoe County were being added each year, the Commission negotiated the purchase of both the development and transmission lines of the company and acquired the entire property on behalf of the municipalities on July 1, 1914. Since that date, the generating station has been enlarged and extended and at the present time it consists of four horizontal units, three rated at 1300 h.p. and one at 2300 h.p. The generators are rated, three at 900 kv-a, and one at 1600 kv-a, 60 cycles, 3-phase, 2200 volts. The total plant capacity is therefore approximately 5800 h.p. The normal operating head at this plant is 58 feet. The generated energy is stepped up to 22,000 volts and distributed to all parts of Simcoe county.

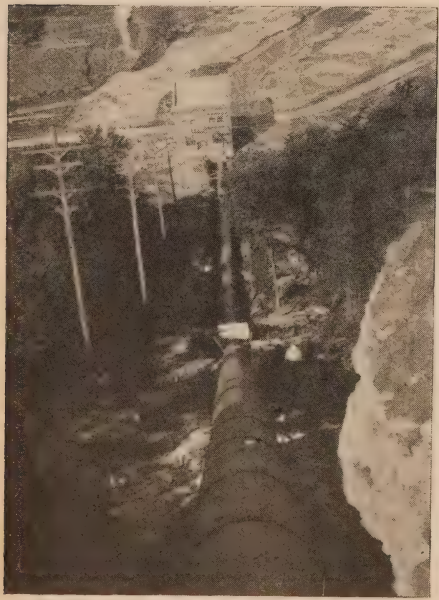
The Eugenia development was constructed by the Commission in 1914 and operates under a head of 550 feet, the highest head of any plant in Canada east of the Rocky Mountains. The generating station has been enlarged and extended since it was first placed in operation and now consists of three horizontal units, two rated at 2,250 h.p. each, and one at 4,000 h.p. All units operate at 900 revs. per min. The

generators are rated two at 1411 kv-a, and one at 2800 kv-a, 3-phase, 60 cycle, 3800 volts. The total capacity of the development, based on machine ratings, is approximately 7500 h.p. Two banks of transformers with a combined rating of 5400 kv-a step up the generated energy to 22,000 volts and the transmission lines cover the entire area of the counties of Grey and Dufferin, the greater part of Bruce, and the northern portions of Huron and Wellington.

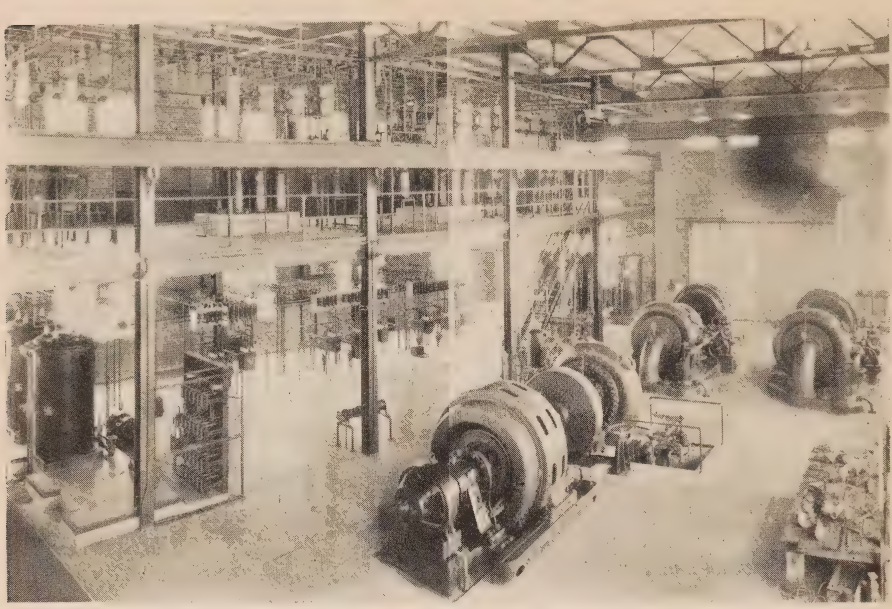
During the year 1916, the demand for power from Munition Plants in Orillia then served by the old Ragged Rapids plant and on the Severn System, was such that the combined output of the Big Chute and Orillia developments was inadequate to carry the load and a transmission tie line between the Eugenia Power House and the Town of Collingwood was constructed by the Commission for the purpose of delivering the the surplus power of the Eugnia development to the points where the demand was greatest, thus tying in Eugenia with the Severn and Orillia systems for the first time, the Orillia plant having been tied in to the Severn system by means of a tie line constructed by the Town of Orillia between Ragged Rapids and Big Chute at the time when the latter development was first constructed. During the years 1916, 1917, and 1918, the Eugenia plant supplied as much as 2,000 h.p. to the Severn system towns and the Town of Orillia. As the Wasdell



Eugenia Development before Second Pipe Line was added.



Eugenia Power House and Pipe Line as Originally Constructed.



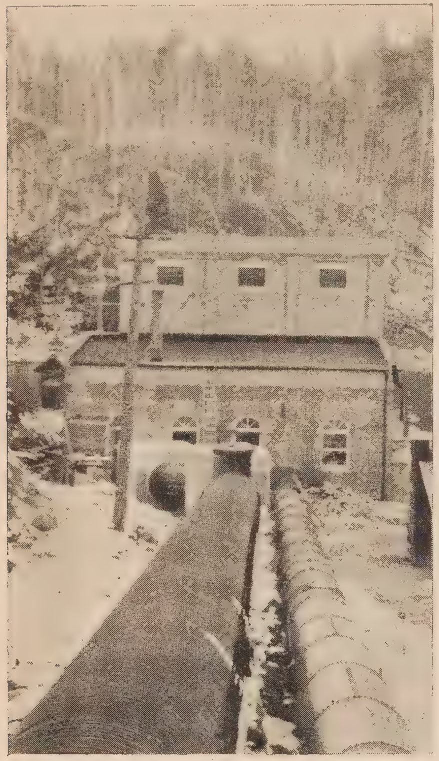
Eugenia Power House, Interior View

development was also under-loaded at that time, a tie line was accordingly constructed between same and Longford Mills, thus tying this development to the Orillia system and enabling the Commission to utilize the entire output of the four generating stations—Eugenia, Big Chute, Orillia and Wasdells, to the fullest extent, and to so effect economy in the use of water as to operate all plants at maximum efficiency. Up to the end of the year 1923 the various systems had been operated as separate units, but the complications involved in keeping accurate cost of power transferred from one system to the other introduced so many difficulties as to practically destroy the benefits obtained by the combined operation. This condition, together with the fact that additional power was urgently needed both in the Eugenia and Severn districts led the Commission to depart from its original policy of operating each system as a separate unit, and at a meeting held on Jan. 31st 1924 the amalgamation of the Severn, Eugenia, Wasdells and Muskoka systems was authorized and later ratified by legislation under an amendment to the Power Commission Act.

The Muskoka system, which comprises the municipalities of Gravenhurst and Huntsville, was created in 1916 when the development originally owned and operated by the town of Gravenhurst on the south branch of the Muskoka River at South Falls was purchased and enlarged by the Commission and a transmission line constructed to Huntsville

and both municipalities served jointly by this Commission from this development. Prior to the time of the amalgamation of the four systems this development consisted of two horizontal units, one rated at 750 h.p., 600 revs. per min. and one at 1000 h.p., 720 revs. per min., the generators being rated at 450 kv-a and 750 kv-a., 60 cycle, 3-phase, 6600 volts, with transmission voltage on line to Huntsville at 22000 volts. Gravenhurst received its power at generated voltage at the power house, transmitting same without step-up over its own transmission line, nine miles in length and stepping down to 2200 volts through its own substation at the receiving end of the line. As the total rated capacity of this development was only 1500 h.p. and as it was capable of being extended and enlarged to develop approximately 7000 h.p. the Commission after careful consideration and investigation authorized the extension of this development to its maximum output, as well as the construction of a tie line between same and Waubaushene on the Severn system, thus enabling the output of this generating station to be pooled with the Big Chute, Orillia, Wasdells and Eugenia stations for the mutual benefit of the entire district, and accomplishing means of obtaining additional power for the four separate systems, all of which were in urgent need of additional generating plant to serve the requirements of their existing and future loads. The changes at this location which are nearly completed, consist of the removal of the original Gravenhurst unit of 450 kv-a. capacity, as well as the original steel pipe line from which same has been operated, the installation of two additional generating units and two additional banks of transformers

Original South Falls Development as Constructed by Gravenhurst, before being Extended and Improved by the H.E.P.C. of Ont.



South Falls Development after first extension by H.E.P.C. of Ont.

together with alterations to the head works and an enlargement of the power house building to house the extra equipment, as well as the installation of the necessary switching and protective equipment and at the same time the construction of a single unit generating station about one half mile further up stream. As the original pondage at this development was insufficient to provide for satisfactory operation of the enlarged plant, and as the Muskoka river immediately above this storage basin narrows perceptibly with discharge through a deep rock channel known as Hanna Chutes, a storage dam is provided at this point which will back up the water for approximately two miles up stream, and afford the opportunity of installing an additional unit of approximately 2000 h.p. at this location. This work, including both dam and generating unit is now progressing. The Hanna Chutes development will be known as South Falls, Station No. 2, to distinguish same from the main development which will be designated South Falls, Station No. 1. Both the turbine and generator at Station No. 2 will be remote controlled from the switchboard of station No. 1 located about one-half mile distant. A wood stave pipe line is provided at Station No. 1 for each of the three units, the pipe lines are 1010 feet in length, two of same being 7 feet

Pipe Lines Under Construction South Falls Development.

in diameter and one 5 feet. They are constructed of B.C. fir and laid on wooden saddles. The turbines are rated two at 2200 h.p., 514 revs. per min. and one at 1000 h.p., 720 revs. per min., and designed to operate under a normal head of 105 feet, the two new units being manufactured by the Wm. Kennedy & Sons, Ltd., Owen Sound.

The two new generators are rated at 2000 kv-a., at 80 per cent P.F. and were furnished by the Bruce Peebles Co. of Glasgow, Scotland, and are being installed by the Commission's Construction Department. The other generator was installed by the Commission immediately after the development was acquired from the Town of Gravenhurst, and has, therefore, been in service for approximately 9 years. All of the three generators are designed to operate at 60 cycles, 3-phase, 6600 volts. The step-up equipment consists of three banks of transformers; one bank of three 400 kv-a. units, 6600 volts primary, 22,000 volts secondary, connected delta-delta supplying the Huntsville line, and two banks of three 1200 kv-a. units, 6600 volts primary, 38,000 volts secondary con-

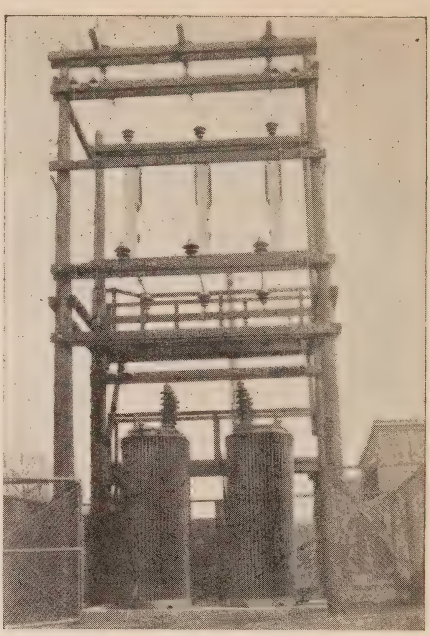
South Falls-Waubaushene Tie Line Angle Tower.

nected delta-star, supplying the tie line to Waubaushene from which the Town of Gravenhurst is also being served. The transmission line between the development and Huntsville will continue to be operated at 22,000 volts for reasons of economy, whereas the line from the development to Waubaushene will be operated at 38,000 volts, for the

South Falls-Waubaushene Tie Line, the Original Gravenhurst Line on the Right.

purpose of insuring better regulation and to keep the transmission losses at a minimum, the distance between the generating station and Waubaushene being 32 miles. The new line traverses a very rocky rough country practically 70 per cent of the poles being set in solid rock. It consists of a single circuit on "H" frame construction, pole spacing being 450 feet, the average pole height 45 feet, and the conductor No. 0000 steel reinforced aluminum cable carried on suspension insulators, 2 in suspension, 3 in strain. The energy received from this line is delivered to the Severn System at the receiving end through an auto transformer, transformation being from 38,000 volts to 22,000 volts. As the old Gravenhurst 6600 volt line and substation had reached the end of its useful life it was decided to scrap both, and serve the municipality off the 38,000 volt tie line through a new substation. The Gravenhurst system being 2-phase, an outdoor type of station was provided consisting of two 400 kv-a. transformers "Scott" connected for 38,000 volts, 3-phase, on the primary side, and 2200 volts, two-phase on the secondary side. This station was first placed in operation on March 26th.

The scrapping of the old Gravenhurst substation and line marks the passing of the last portion of the original Gravenhurst plant in service when the development first came into the possession of the Commission in 1916. The first change inaugurated by the Commission was an enlargement of the power house and the addition of a new unit. The



Gravenhurst Sub-Station.

present change has so altered the power house building that scarcely any of the original structure remains, and the removal of the first Gravenhurst generator and pipe line as well as the transmission line and substation have, therefore, completely eliminated the original properties of the town system in so far as generation and transmission are concerned. Changes of this kind mark the progress of the times and the benefits derived by a co-operative scheme of power distribution through the medium of the Hydro-Electric Power Commission of Ontario. Thus, a small plant of 500 h.p. serving one town under a large capital expenditure, has become a development of 7,000 h.p. serving a large group of municipalities, with the original town served with a greatly increased demand at re-

duced capital and greater efficiency.

To provide additional power for the Eugenia district the Commission in 1923 constructed a frequency changer station at Mount Forest and obtained power from the Niagara System, over a transmission line constructed between Harriston and Mount Forest for this purpose, thus tying in the Niagara System with the four systems which have recently been amalgamated into the Georgian Bay System. Niagara power is obtained from the Stratford transformer station, transmitted over the 26,000 volt line to Harriston, and the Niagara-Eugenia tie line between the latter point and Mount Forest, changed from 25 to 60 cycles in the frequency changer set, and delivered to the Eugenia system. The frequency changer consists of a 3-phase, 1150 kv-a., 25 cycle synchronous motor fed from a bank of three 350 kv-a., 25 cycle transformers 26000 volts primary, 2200 volts secondary, direct connected to a 1000 kv-a., 60 cycle, 3-phase generator, the energy of which is stepped-up from 2200 to 22,000 volts through a bank of 3-300 kv-a. transformers and fed into the Eugenia lines. In order that the output of the Eugenia development could be utilized to greater advantage in conjunction with the Mount Forest frequency changer supplying Niagara power, and to obtain the full capacity for peak load purposes of the generating units installed, a second pipe line was constructed at Eugenia. As the original pipe line could only deliver water for generating purposes up to about 5800 h.p. and as the rated capacity of the turbines was in excess of 8000 h.p. the second pipe line gives ample security for delivering sufficient water to provide for the maximum output of the turbines. Thus, the inclusion of the Eugenia development with its large peak capacity together with the Niagara auxiliary at Mount Forest in the Georgian Bay System makes a valuable and much to be desired contribution for the amalgamated systems. The operation of the various generating plants and the frequency set at Mount Forest as a combined unit present some most interesting problems, the solution of which has been successfully accomplished. With the Wasdells plant operating under a 14 foot head of 1100 h.p. capacity, the Orillia and Big Chute plants operating at 58 foot heads, each with a capacity approximating 5800 h.p. the Eugenia plant operating at a 550 foot head, with a capacity of 7500 h.p., the new Muskoka development operating at heads of 30 and 105 feet with a total capacity approximating 7000 h.p., one unit of which is located one-half mile from the main power house and remote controlled from same, all 60 cycle stations, and the Niagara System with its tremendous generating capacity behind its net work of transmission lines at 25 cycles feeding into the combined systems through a synchronous motor generator set, together with the Muskoka transmission line delivering its quota of power at 38,000 volts through auto transformers, and with various generator speeds at various plants,

and with 90 miles of 22,000 volt line between Eugenia and Big Chute, it can be readily realized that the accomplishment of successful operation has not been a simple task, and great credit is due both to the Engineering and Operating Departments in the results obtained. With a reservoir of approximately 300 square miles in Lakes Simcoe and Couchiching, and with a stream with a drainage area of 2265 square miles, the three Severn River plants possess characteristics which enable them to be operated at a very high load factor, while the Eugenia plant located almost at the head waters of the Beaver River with an artificial pondage of 1800 acres, although possessing great potentiality in a head of 550 feet is essentially a low load factor plant, capable of taking care of heavy peak loads, but limited to a small capacity for continuous loads. The south branch of the Muskoka River with a somewhat smaller drainage area than the Severn, but with excellent storage facilities afforded by the Lake of Bays is capable of operation at medium load factor, while Niagara power from the frequency set at Mount Forest, although obtainable at off peak periods only, is available for at least an average of 20 hours per day. Thus, with the three high load factor plants available capable of delivering to the combined systems approximately 9000 h.p. almost continuously, assisted by 1000 h.p. for 20 hours per day from Niagara, and 7000 h.p. at 50 per cent load factor from Muskoka and with Eugenia capable of carrying 7500 h.p of peak load, the Georgian Bay System is well equipped to cope with its power demands, both existing and future for at least three or four years to come. Taking all of these factors into consideration it is easily recognized that the great problem which confronts the Commission in supplying the districts served by the combined Georgian Bay System is that of water. Stream flow must be properly and carefully regulated, storage secured and maintained at every possible location and the various generating plants so operated as to conserve water and obtain the greatest possible output from every second foot of water available. This then is the reason for the amalgamation of the various systems and the pooling of the various plants into one theoretical generating station, each development equivalent to a generating unit, with the tie transmission lines functioning similar to the cables between a generator and switchboard of a standard station.

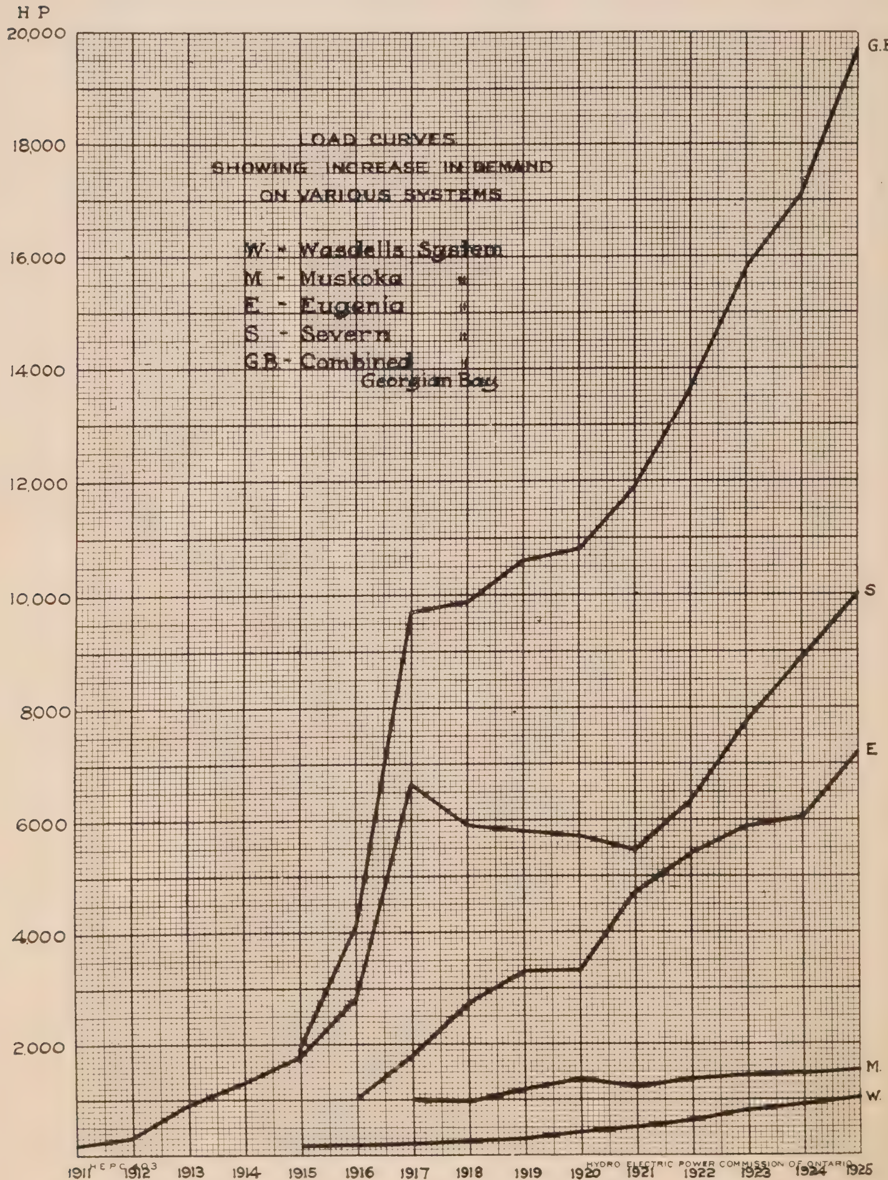
The activities of the Commission in the Georgian Bay District as now constituted originated with service to the Towns of Midland and Penetanguishene in 1911. The demand in Midland during the first year of operation approximated 200 h.p., whereas, in 1924, after thirteen years of Hydro service the demand was nearly 3400 h.p., being an increase of 1600 per cent during that period. The average increase in demand for Midland during the same period was 266.8 h.p. per annum. Conditions throughout the various units comprising the com-

bined Georgian Bay System have been similar to Midland, although the growth has not been quite as extensive, the following table setting out the actual growth to the end of 1924,—

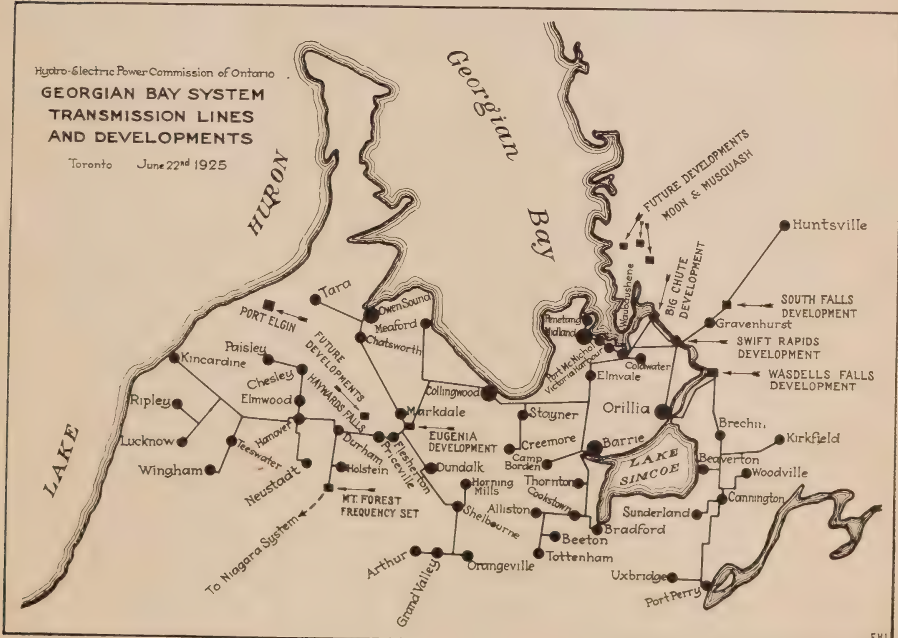
SYSTEM		Urban Municip-alities served.	Rural Power Districts served.	Load Sold in H. P.	Total Percent increase in load.	Average increase in H. P. per annum.
Severn —	1911	2	0	304	—	—
	1924	16	4	8848	2810%	657.2
Wasdell —	1914	5	0	182	—	—
	1924	9	4	878	382%	69.6
Eugenia —	1915	6	0	1047	—	—
	1924	25	5	5963	469%	546.2
Muskoka —	1916	2	0	1008	—	—
	1924	2	0	1411	40%	50.4
Georgian Bay —	1924	52	13	17100	—	—

The average increase for all systems combined has been, according to the above table, 1323 h.p. per annum, which clearly sets out the necessity of constantly providing additional plant capacity to keep up with the ever increasing demands in this district and the efforts which the Commission have put forth to meet these requirements in the past will merit particular attention. The initial service in the district was given, as previously stated, to the towns of Midland and Penetanguishene in 1911, power being obtained by means of purchase from the Simcoe Railway & Power Company's development at the Big Chute on the Severn River. This development was purchased by the Commission in July 1914, the capacity of which at that time was 2,700 kv-a. The Wasdell Development was also placed in operation later in 1914 being the first hydraulic plant constructed by the Commission, the installed capacity of which was 800 kv-a, closely followed by the construction of the Eugenia development in 1914 and 1915, the initial installed capacity being 2822 kv-a. The construction of the Eugenia-Severn tie line between the Eugenia Development and Collingwood and the Wasdells-Orillia tie line between the main transmission line of the Wasdells system and Longford Mills and the execution of an agreement with Orillia covering the purchase of all surplus power, made possible

the utilization of the combined capacities of the four generating stations in the year 1916, thus providing means of obtaining additional power for each individual district, as well as securing greater reliability for operating purposes. During the Fall of 1916 the Commission purchased the Gravenhurst development at South Falls now designated "The Muskoka Development" and constructed an extension to same



consisting of an enlargement to power House, improvements to Forebay, the installation of a wood stave pipe line and a 1,000 h.p. turbine generator which was followed in 1917 and 1918 by an extension of the Big Chute development consisting of the installation of a 2300 h.p. turbine driven generator together with the necessary power house changes and step-up transformer capacity. In 1918 an extension was constructed to the Eugenia development consisting of the installation of a 4,000 h.p. generating unit together with the necessary step-up switching and protective equipment and power house changes to provide for this additional output. In 1923 the Mount Forest frequency changing station was installed making possible the purchase of 1000 h.p. "off peak" power from the Niagara system, a second pipe line was also constructed at Eugenia during the same period, thus providing for the generation of the full capacity of the installed equipment, viz: 7500 h.p. and increasing the peak output of this plant by approximately 2,000 h.p. Finally, the last effort put forth by the Commission provides for taking care of increased demands in the district, by means of a further extension to the Muskoka Development and the construction of a tie line between same and Waubaushene previously described, increasing the capacity of this development from 1500 h.p. to its total maximum output of about 7000 h.p. The accompanying curves portray graphically the condition of growth on the various individual systems as well



as on the combined system from the time of initial service to date, and as the indications are that the growth in demand for electrical energy in this district will continue year by year the Commission is forced to constantly concentrate on the future to provide sufficient development to adequately cope with these conditions; surveys, therefore, have been authorized covering developments at Port Elgin on the Saugeen River, the possible output of which may vary from 5000 to 10,000 h.p. at Port Severn at the mouth of the Severn River where 2000 h.p. is possible, and on the Moon and Musquash Rivers, from which preliminary investigation indicates a possibility of obtaining from 18000 to 20000 h.p. at three different sites. All of these future developments are located within the Georgian Bay District as indicated on the accompanying map and are adjacent to existing developments and quite close to existing transmission lines.

Italian Delegation's Visit to Niagara Falls

The following is a translation of an extract from the report of Professor Muzi of the University of Pisa, giving his impressions of the visit of the Italian Delegation, along with the British Association for the Advancement of Science, to Niagara Falls. His remarks are of interest as they convey the impression that foreigners gain of our organization. In reproducing this translation, the Bulletin does not take any responsibility for the correctness of the statements given in it

DURING congress week, a day was dedicated to a visit to Niagara Falls. I recollect that it was a magnificent day and the sky was nearly as blue as that of Italy with an atmosphere so transparent and crisp which brought out all things in bold relief. The shores of the great Lake Ontario which was calm when we crossed, were full of light and colour.

I went to Niagara a little bit skeptical like many who had read and re-read of the famous Falls and believed to be a little bit exaggerated but I was immediately convinced of its hydraulic potentiality.

Niagara Falls is not very high (about 50 metres) but the mass of water is enormous. On account of the fact that the Falls mark the boundary line between the United States and Canada, one of the shores belongs to the United States of America and the other to Canada. The two Governments have long since specified the division of the water powers. The development of the American shore is less recent, consequently a greater population and more industrial intensity. On the other hand the Canadian shore has only been developed in the last few years and on a different system.

It is a series of gardens, public parks, villas and luxurious hotels. The flow of travellers and automobile movements is enormous. The country surrounding is so well cultivated that it looks like real gardens.

Of the Hydro-Electric central stations on the Canadian side we visited the most famous and the largest one of all called the Queenston-Chippawa, constructed by the Government of the Province of Ontario for a municipal confederation which to-day numbers 280. This great plant contains to-day eight (which will be eleven when completed) groups of turbine alternators, each one of 60,000 h.p. These units are the largest so far manufactured. The energy produced from this plant, which when completed will be over 600,000 h.p. along with the output of other plants is distributed over the greater part of Ontario by a great net work at 110,000 volts.

This great and beautiful work deserves a longer technical description which I feel would not be in order in a review of general information. I will describe briefly the organization of this public work which to my mind, of its kind is the greatest in the world.

When in 1900 the industrial and agricultural development of the Province of Ontario began the greater amount of electric power needed came from the U.S.A. This dependence became more irksome and the Ontario Government, urged by public opinion, and energetic action of the larger municipalities, was induced to study this ever growing problem. The studies were completed in 1906 and by a special law the Hydro-Electric Power Commission or in brief, the Hydro was created. This Commission is composed of only four members, the illustrious Sir Adam Beck, President, J. R. Cooke, Commissioner, W. W. Pope, Secretary, F. A. Gaby, Chief Engineer. These men enjoy the complete faith of all as technicians, organizers, business men and men of integrity. The powers given them by the special law above mentioned are many and great and are allowed complete liberty of action although belonging to a public corporation.

The idea of this great work is to furnish the municipal confederation with electric energy at cost which, of course, involves the interest on the amount of capital invested. The capital was provided by the Government. The municipalities have agreed with guarantees to return the capital and interest inside of thirty years.

The hydro builds and operates directly the power plants and high tension lines and the municipalities provide the local distribution. The greatest work of this Commission is the Queenston Central Station. The Commission has acquired and developed other great plants in the Province of Ontario.

(The statistics that follow are for 1923)—

There are 22 central stations with a combined capacity of 700,000 h.p. and when completed will reach 1,000,000 h.p. The high tension lines have a total length of 5600 kilometres, 1400 kilometres are for rural services for one-half of which

the Government has paid 50 per cent of the cost. The capital invested together with the distribution system of each municipality is about $242,000,000 (about 5,500,000,000 lires). The income of 1923 was about $16,000,000 (about 370,000,000 lires) of which $345,000 was returned to the municipalities in the fiscal year of 1923 after paying all costs, interest, reserve, etc. The net profit for 1923 was over $1,000,000 and the reserve accumulated by the Hydro and the municipalities about $34,000,000. The sale price to the consumer naturally varies in each city and depends on the conditions, distance, population, etc. The average prices, however, represent the minimum rates of America. Even in absolute value it is lower in many cities than in most Italian cities.

It is not the intention to enter into further particulars. I just wanted to call your attention to this great public electric work, the greatest, I repeat, in the world. All Canadians are justly proud of it and take great interest, each considering it as their own. Apart from any other consideration is the fact that the national, social and educational value of this great work is superior to its financial success.

Population and Use of Power

Canada possesses minimum water-power resources of over 18,000,000 twenty-four hour horse-power distributed from coast to coast at advantageous sites near the centres of industry, and in the East and West enormous reserves of coal and other fuel.

That she is making use of her great power resources is shown by the facts that during the past ten years the developed water-power has increased from 1,936,000 horse-power to 3,570,000 horse-power or nearly 85 per cent, and the water-power developed per 1,000 of the population from 252 horse-power to 387 horse-power.

During these past ten years, while the population increased 20 per cent. the use of power per head of the population increased nearly 54 per cent.—*Natural Resources Canada.*

Investment in Canadian Water-Power.

The total water-power developed in Canada as at February 1, 1925, was practically 3,570,000 horse-power, and the capital invested therein, including transmission and distribution, was $766,758,000. In 1910 the investment stood at $121,000,000, so that the average annual increase over the 14 years has been nearly $646,000 or 14 per cent per annum.—*Natural Resources Canada.*

Municipal Emergency Radio

F. K. D'Alton Assistant Laboratory Engineer, H.E.P.C. of Ontario.

THE City of London, Ontario, is the first municipality on the power systems of the Commission to use radio equipment for communication in emergencies between its transformer substations, and from its substations to the high tension transformer station supplying them with power.

During the early part of May of this year, the Laboratories installed three complete guided radio sets for the Public Utilities Commission of London. These were placed in the two substations, at Horton and Ridout Sts., and on Cabell St. respectively, and the third set was installed in the pumping station in Springbank Park, about four miles west of the city.

These radio stations can communicate with each other in any of the three combinations desired, the voice signals being very pure and exceptionally loud. This channel does not use the telephone lines and therefore is entirely independent of faults occurring on these circuits.

The equipment is as simple as possible consistent with good and reliable operation, and is shown in the accompanying illustrations.

The front views of both transmitter and receiver appear in Fig. 1. It will be observed that there are only two adjustments on the transmitter, namely, the filament rheostat in the lower left and the grid inductance, or regeneration control, in the upper centre, whereas the receiver is supplied with adjustable removable coils, variable condensers with verniers and filament rheostats, to render it as flexible as possible, and to allow of sharp tuning when desired.

The rear views, with cabinets removed, are shown in Fig. 2. The transmitter, here on the left side, will be seen to contain very few parts, while the receiver, somewhat more complicated, still has fairly good spacing, which feature is very desirable in making repairs or replacements.

In the top of each cabinet is a door allowing the removal of tubes without disturbing the equipment in the cabinet.

The transmitter and receiver are placed on a table in the positions shown, Fig. 1, and connected together through a switching system whereby either the aerial or telephone lines may be selected as the channel of communication and with a transmit-receive switch which is thrown alternately from one side to the other during a conversation.

The aerials used with these sets are placed close to the 13200 volt power lines and are quite short. The capacity effect of these aerials to the power lines is approximately 0.001

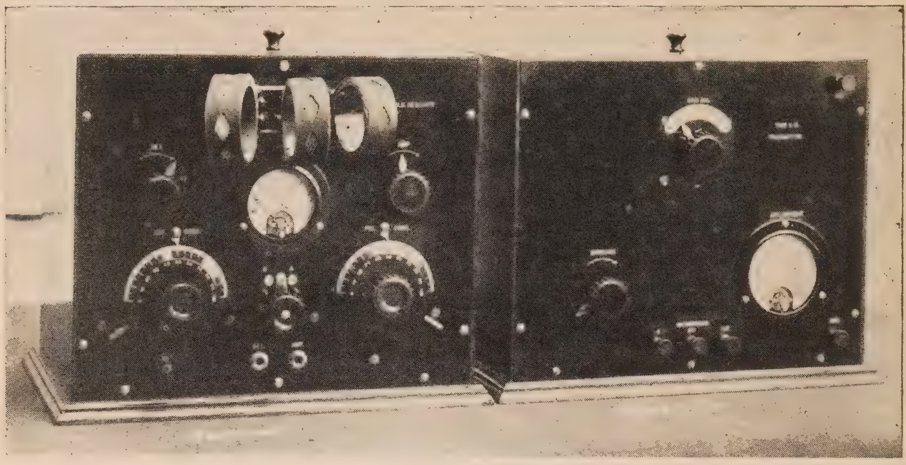


Fig. 1. Front View of Guided Radio Transmitter and Receiver.

microfarad.

In carrying on a conversation, the stations communicating transmit alternately, each giving the other a definite signal when it is desired to reverse the direction of transmission. The one way system, or transmitting in one direction only at any one time, is somewhat different from the duplex system of the ordinary telephone, but has some advantageous features. Since it is usual on power systems to have instructions given from one central point, the one-way system allows complete instructions to be sent without interruption from the station receiving the transmission. The receiving operator will listen more intently when he knows he cannot ask questions during the

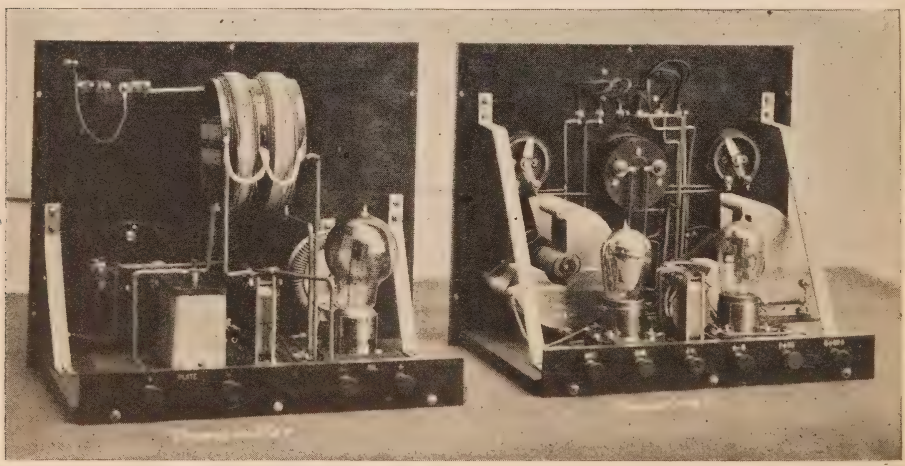


Fig. 2. Rear Interior Views of Guided Radio Transmitter and Receiver.

issuing of orders, and as a rule it is not necessary to restate the instructions but merely to have the receiving operator advise briefly that all messages have been received satisfactorily, and then to answer any questions that have been asked of him.

The tuning of these stations, particularly when operating over single sections of the lines, is very broad, signals very loud, and in consequence, the operator will receive messages clearly when only roughly tuned to the transmitting station.

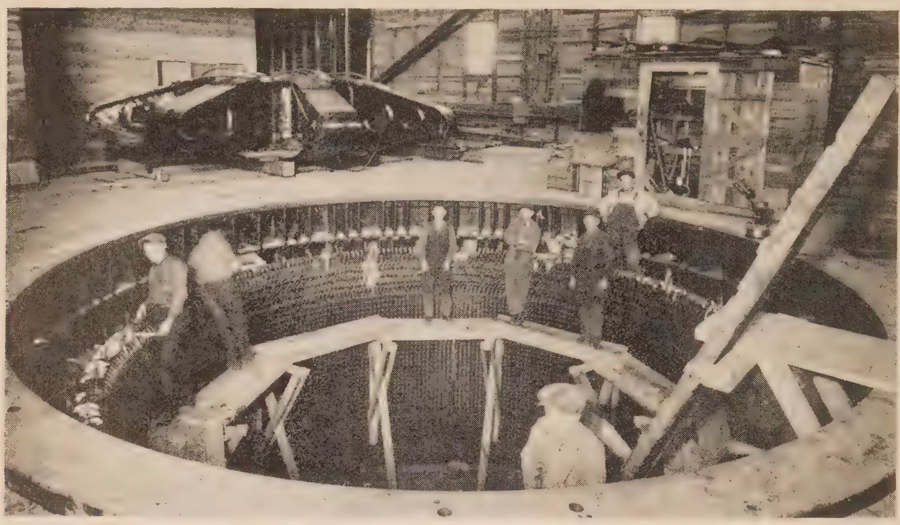
This radio system is supplementary to the existing telephone circuits, and both may be used at the same time, without any interference of one circuit with the other. There is not any trouble from induction by the power lines: all induced charges are drained to ground and do not produce audible sounds in the receivers.

At the time of installation, a radio calling system was not attached to the sets but the addition of such is contemplated. There are several methods which are satisfactory for radio systems that give very strong signals where the number of stations does not exceed two or three. The most simple system consists in extra amplification, together with a loud speaker, at each receiver to announce voice or buzzer calls from any of the transmitters to which the receiver is tuned. All transmitters require to be set precisely on the same wave length and all receivers kept in tune, with the receiving valves left burning continuously. There are other methods of calling which employ relays and are much more complicated.

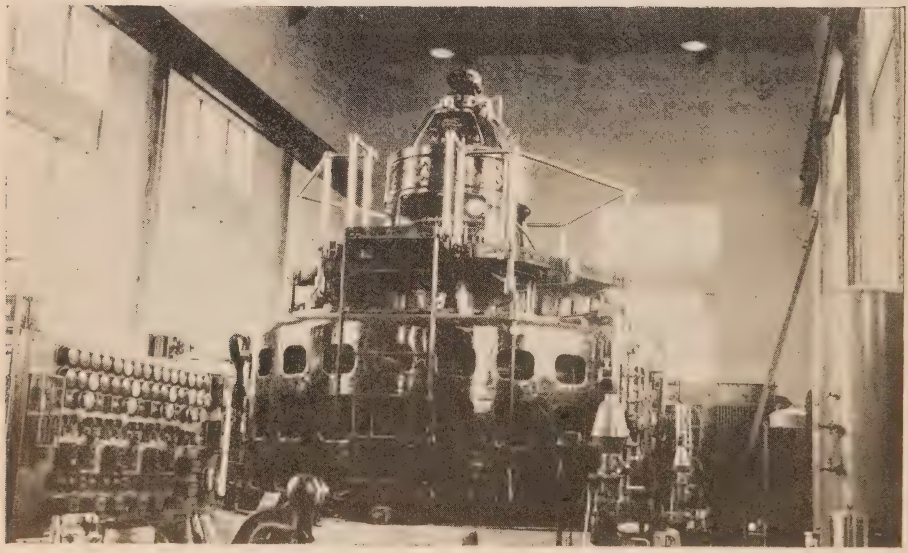
The calling system incurrs a greater maintenance expense than operation for communication only, on account of the comparatively short life of the tubes and the attention to the storage batteries. It would be desirable in such radio calling systems to light the filaments by alternating current through a specially designed transformer, and thus relieve the storage batteries of all load, except during conversations.

Relay systems, giving signals through a bell, buzzer or light, are not altogether satisfactory where there are not special radio operators in attention, on account of the precision necessary in the tuning of the receivers.

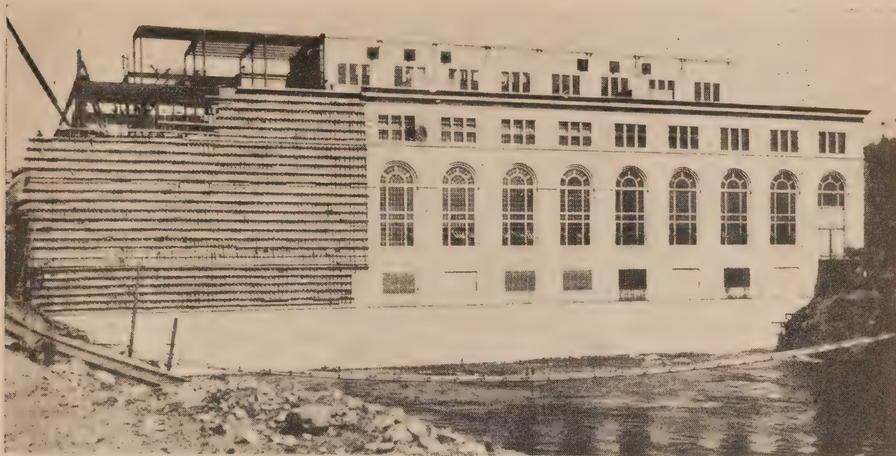
The radio system which has just been completed in the London stations uses equipment which is similar to the guided wave sets on the Commission's High Tension Lines. Both transmitters and receivers have been brought to a thoroughly practical form, with few parts to get out of order and give every assurance of reliable operation, even in the hands of operators who have had little experience with radio equipment.



Connecting up Armature Coils, No. 8 Generator, Queenston Power House.



Dam No. 9 Generating Station, on Trent River near Campbellford. Interior View showing one of the 1,400 kv.-a. automatic controlled 6,600 volt, 3 phase, 60 cycle, 180 revs. per min. water wheel driven generators, also switchboard and governor. This station was placed in service during the early spring.



Nipigon Power House showing work on building for units Nos. 5 and 6.

This picture shows a condition under which we operate in the North Country which those in Older Ontario do not realize. It shows a method adopted on some parts of the Nipigon System for transportation during the winter months.

Hydro News Items

Central Ontario System

The City of Peterboro is having estimates prepared on the cost of rebuilding the present multiple street lighting system: at present this is being done for the east end of the City only, but should the cost of doing the work not prove excessive, the proposed improvements will be extended over the whole city.

* * * *

In several municipalities on the C. O. S., rural lines have been extended outside the municipal limits, the capital being included in that of the local system. Valuations are now being made of these lines in order that the rural bonus may be obtained and all consumers placed on a regular rural basis.

* * * *

The work on the new circuit from Norwood station to Havelock is now proceeding satisfactorily. This circuit will carry the C. P. R. load.

* * * *

Estimates are being prepared on the rebuilding of a portion of the Cobourg distribution system.

* * * *

Georgian Bay System

The local Commission of Midland is making provision to remove all overhead lines from the main business street and arranging to construct primary and secondary lines in lanes parallelling same. An underground street lighting cable is being installed on both sides of the main street feeding a new system of street lighting consisting of vertical cast iron columns which are replacing the present overhead system.

* * * *

The construction of the new elevator at Owen Sound is progressing and arrangements are being made to enlarge the local substation by means of the installation of another bank of transformers to take care of this additional load. It is expected that the new elevator will be ready for service in the Fall.

* * * *

The summer resort district at Wasaga Beach near Collingwood and Stayner on the Georgian Bay is building up rapidly and approximately thirty new contracts have been secured this season. About 150 customers are being served at the present time and the indications are that in another year's time over 200 cottages will be receiving Hydro service.

* * * *

The extension to the South Falls Development, which supplies a portion of the Georgian Bay System is progressing favorably. The first of the new units has already been in

operation for some months and the second unit is being erected and will probably be placed in service in the course of the next few weeks. Work has already started at Hanna Chutes, at which point a third unit is to be installed remote controlled from the main station.

* * * *

The Annual meeting of the Eugenia Electrical Association was held in Wingham on Wednesday (June 10th) at which various general matters pertaining to the municipalities as a whole were discussed by the various delegates and by representatives of the Commission attending the meeting. An effort will be made in future to induce the municipalities of the Severn, Wasdells, and Muskoka divisions, all of which form part of the Georgian Bay System to co-operate with the Eugenia Association for the purpose of forming one general association for the entire district.

* * * *

Niagara System

The Village of Richmond Hill carried the Hydro by-law on June 15th. The Village has received its power supply from the Toronto & York Radial Company since 1912, and as the agreement with the Company expired, the Village is arranging to secure its power supply from the Commission. Power will be supplied as formerly, from Bond Lake substation at 4000 volts.

* * * *

A new substation, consisting of 1—300 kw. three phase, outdoor type transformer has recently been put into service near Cayuga to supply power to the Town of Cayuga and district. It is expected that a considerable mileage of rural lines will be required in this district in the near future.

* * * *

A 4000 volt line has recently been completed from Aylmer to the Village of Springfield. Springfield has been served since 1917 by a 2200 volt rural line from Tillsonburg. The increasing loads in Springfield, and the requirements of the rural district, made the change necessary.

* * * *

Shipments have commenced on No. 9 unit for the Queenston-Chippawa plant. This machine is to be in operation by November of this year.

* * * *

The third bank of 3 - 5000 kv-a 110,000 volts to 13,000 volt transformers has just been installed at the Toronto Wiltshire transformer station. A third bank of similar size is being installed at Bridgeman station, and underground cable connections are also being installed between Davenport and Bridgeman Stations.

* * * *

The Hagersville station and distribution system has recently been changed from 2200 to 4000 volts.

* * * *

A second 300 kv-a outdoor type transformer has been added to the Lincoln station at St. Catharines, bringing the capacity to 600 kv-a.

* * * *

The growth of load in the Dundas

Rural Power District has necessitated changing the substation capacity from 1 - 300 kv-a to 3 - 150 kv-a transformers.

* * * *

Rideau System

The Town of Almonte has been contemplating the rebuilding of the Hydraulic Generating Plant and has submitted a by-law to raise $47,500, to the Ontario Municipal Railway Board. The site chosen for the new plant will give a greater plant capacity and more head than the present location. Due to the good financial condition and revenue derived from the Utility with its present customers, the charges incurred by the new development can be carried without any adjustment of rates.

* * * *

The Perth Hydro Electric System has been giving some consideration to the purchase of new street lighting fixtures. It has finally been decided to install a modern suspended unit of large candle power in the middle of the street. The Municipality is anxious to have the system complete prior to an Old Boys' Reunion which is to take place the latter part of June.

* * * *

St. Lawrence System

Estimates have been prepared and submitted to the Police Village of Russell on cost of power, distribution system and resale rates. It is proposed to supply this Municipality in conjunction with rural service, by a line from the Chesterville substation.

List of Electrical Material, Devices and Fittings

Approved by the Hydro-Electric Power Commission of Ontario in May, 1925.

Appliances

BELLEVILLE ELECTRIC & STAMPINGS, LTD., 100 Church St., Belleville, Ont.

"Leader" Portable Flat Iron.

* * * *

CANADIAN IRONING MACHINE CO., LTD., Woodstock, Ont.

"Simplex Junior" Ironing Machine

* * * *

THE CONTINENTAL ELECTRIC CO., LTD., 507 King St., E., Toronto, Ont.

"Royal" Hair Dryer.

"Royal" Hair Clippers.

* * * *

THE FITZGERALD MFG. CO., Torrington, Conn.

"Star-Rite" Electric Marcel Waver.

* * * *

HANOVIA CHEMICAL & MFG. CO.,

Newark, N.J.
"Alpine" Mercury Vapor, quartz tube burners.

* * * *

THE MOORE ELECTRIC CORPORATION, 845 South Wabash Ave., Chicago, Ill.
"Moore" Hair Clippers.

* * * *

THE NORDHEIMER PIANO & MUSIC CO., LTD., 220 Yonge St., Toronto.
"Duo-Art" Player Piano Action.

* * * *

THE PHONOMOTOR COMPANY, 121 West Ave., Rochester, N.Y.
"Phonomotor" Phonograph Unit.

* * * *

THE CANADIAN GENERAL ELECTRIC CO., LTD., 212 King St., W., Toronto.
Portable Display Rack. "Edison Mazda Lamp."

* * * *

GRANT & THORPE, 418 George St., Peterborough, Ont.
Portable Display Rack.

* * * *

NORTHERN ELECTRIC COMPANY LIMITED, 131 Simcoe St., Toronto.
Amplifier Units, Types R25-A and R115A. "Northern Electric Co. Limited."

* * * *

THE FRANK E. WOLCOTT MFG. CO., Hartford, Conn.
"Curlex Special" Electric Curling Iron.
"Eclipse" Hair-drying Comb.

* * * *

*FANSTEEL PRODUCTS CO. INC., (Mfr), North Chicago, Ill.
BURNDEPT OF CANADA LIMITED (Submittor), 130 Richmond St., W., Toronto.
"Balkite B". Current Supply Unit.

* * * *

*GILBERT COMPANY, THE A. C., New Haven, Conn.
Portable Electric Air Heater.
Electric Hair-Drying Machine, Type "D". Marking: "Polar Cub Type D."

* * * *

Switches

SMITH & STONE, LIMITED, Georgetown, Ont.
"S. and S." surface switches, Cat. No. 1800.
Porcelain sub-base for use with surface snap switches.

* * * *

Fittings

THE SIEMON COMPANY, Bridgeport, Conn.
"Siemon" Composition weather-proof sockets.

* * * *

THE CANADIAN GENERAL ELECTRIC CO., LIMITED, Peterborough, Ont.
"C. G. E." Porcelain tubes.

* * * *

Lighting Devices

CHADWICK-CARROLL BRASS CO., LTD., Hamilton, Ont.
Portable Electric Lamps. "C. C. B. Co."

* * * *

NERLICH & CO., 146 Front St., W., Toronto, Ont.
Portable Electric Lamps. "Nerlich & Co."

Miscellaneous

*PANELYTE BOARD CO., THE, Enterprise Ave., Trenton, N.J.

"Panelyte Board." Insulating Material.

* * * *

*These devices are under the Underwriters' Laboratories re-examination or label service.

On the Buying End

The dealer gazed soberly at his balance sheet for the year. "Only 3 per cent net for twelve months of hard work," he remarked, "and I have had a good volume of sales." He leaned back in his chair thoughtfully.

His visitor picked up the sheet from the desk, and studied it carefully. "Your stock looks large for the amount of sales," suggested he, "and there are a lot more facts I would like to have dug out of your books."

"But I can see that your turnover is too small," continued the visitor. "Let's look over a statement of your stock, as shown by your last year's inventory,—the figures by departments, separate figures for the big items like washing machines, and a complete record of your purchases and sales." "All right," said the dealer, "I will bring that stuff along when I see you in the city." So the interview ended.

Before the time of the proposed meeting arrived, however, the dealer knew what his trouble was. Briefly this is what he discovered:

1. Some of this stock had been on hand two years.
2. Certain lines, representing a considerable investment, had made only half a turn.
3. His stock of radio had turned three to four times.
4. His fixture stock had made but two turns.
5. Three new specialties had stuck hard and fast without a single sale.
6. The total stock showed but two turns for the year.

This may be an extreme case but various gradations of this only a trifle less worse, are by no means uncommon.

Buying is a store problem that calls for careful thought and seasoned judgment. There is plenty of real truth in the statement "Goods well bought are half sold."—*Electrical Merchandising.*

Re. Municipal Populations

To enable The Bulletin to give as nearly as possible the correct populations of the Hydro Municipalities as shown in the lists on the inside of the cover, it would be of considerable assistance if the Municipal Officials advise of any corrections that should be made.

—Editor.

THE
BULLETIN

Published by
HYDRO-ELECTRIC POWER COMMISSION
of Ontario

190 University Avenue
Toronto

Subscription Price $2.00
Per Year

Opening Address

By V. S. McIntyre, President.

ON behalf of the officers of the Association of Municipal Electrical Utilities, I wish to welcome you to our Annual Summer Convention. This Convention, as you know, is a joint Convention of the Ontario Municipal Electrical Association, our parent organization, and our Association. Those of you who attended our joint Convention in Toronto last January will agree with me that it was a most successful meeting, both in point of attendance and for the wealth of information produced for each individual. We have gotten off to a good start today, and all signs indicate a Convention that will even excel the January one.

As you will see from your programme, our various Committees have been untiring in their efforts to provide you with good speakers, good papers, and entertainment. Mr. Maguire, President of the O.M.E.A., will take charge of this meeting a little later on, and is going to bring up several matters which are of the most importance to all of us, and to the industrial life of this Province.

Since our January meeting our Executive has been busy with various matters in connection with our Association and the electrical industry at large. I will not go into the detail of the work accomplished by our Association, since our last meeting, as the Chairman of the various Committees will present reports covering their activities. After hearing these reports I feel sure that you will agree with me in saying our Association is to be congratulated on having such active Committees.

During the past few weeks we have been very much interested, along with members of the C.E.A. and the Manufacturers' Association, in taking up with the Government at Ottawa matters pertaining to their Department governing Inspection of Electrical Meters. There is no doubt that shortly a change will be made in the Electrical Inspection Act, and the Committee which you appointed last year to work in con-

CONTENTS

Vol. XII. No. 7
JULY, 1925

junction with Committees appointed from the other organizations just mentioned has been active in protecting the interests of the central stations, meter manufacturers, and the electrical consumers. Up to the present, the Government has taken no direct action in this matter, but we expect to be able to present a report in the near future.

I know all of us regret very much that Sir Adam Beck is not able to be with us. We know, however, that Sir Adam is here in spirit and is wishing us every success in our deliberations, and we all join in sending him our sincere wishes for a speedy recovery.

As Managers, Engineers, Superintendents of Electrical Departments, purchasing and distributing electrical energy to our consumers, we will be faced, within a short period, with another problem, a problem which we had to cope with during the year 1918. Sir Adam Beck, in his statement protesting against the exportation of Electric Power, with special reference to the proposed lease of the "Carillon" Power Site, published last month, says:

> "On other occasions I have drawn attention to the fact that the citizens of Ontario are now facing a most serious power shortage. Its gravity can scarcely be overstated. Within the short period of 15 years, Ontario will need every horsepower that can be developed from its water powers, and the markets will absorb this power as rapidly as it can be produced. The available Niagara power supply is being utilized as rapidly as the necessary equipment can be installed, and, under present allotments of water, all available Niagara power will be utilized in 1926."

This means that all available Hydro power in the Niagara district will be taken up next year. The Hydro Power Commission is making arrangements to take care of extra demands on the Niagara System through the installation of a steam plant located in Toronto. The necessity for the erection of such a steam plant has always seemed to me to be a shame when you take into consideration the amount of Hydro power going to waste on the St. Lawrence River which could be utilized to relieve the Niagara situation. Those of us who are located on the Niagara System will have to study load regulation. Each one of us will have to regulate our individual power demands so that the generating stations here can be operated at their maximum efficiencies.

During the past year the Government has passed legislation enabling

the Municipalities to tax Hydro Stores. This, to my mind, is a move in the right direction. Those of us who operate stores have been criticized on the score of not paying taxes, and such regulations will remove any arguments along this line.

In attempting to make a Presidential Address, I am putting forth my best efforts, endeavouring to be as concise as possible and to make the virtue of my remarks lie in their brevity. In closing, I would like to leave this thought with you:—

In the past we have heard a lot about service. Service is a most important point in our operation. There is, however, something else just as important which must be exercised in order to give service, and that is co-operation. Co-operation with the Provincial Hydro Commission; co-operation between our two Associations; co-operation in the office, in the substation, in the workshop, so that it will be an inducement to individual effort and individual initiative. Co-operation should be the way of the electrical industry and, if this Association can contribute substantially in effort and in inducement, in research and results, to so shape the electrical industrial progress of this Province it will deserve well of those in whose service it is engaged.

Sir Adam Beck's Message to the Convention

Mr. T. J. Hannigan,
Secretary, Ontario Municipal Electrical Association, GUELPH,
and
Mr. S. R. A. Clement,
Secretary, Association of Municipal Electrical Utilities, TORONTO.

Dear Sirs;—

In acknowledging your very kind invitation to attend the annual banquet of the Ontario Municipal Electrical Association and the Association of Municipal Electrical Utilities, I desire first of all to express my deep appreciation of your kindness and to say that if it were not for limitations at present placed upon me I should be most happy to be present with you on the evening of the twenty-fourth of June.

Those of us who are familiar with the history of the publicly owned hydro-electric utilities of this Province know that the splendid assistance rendered by you has greatly contributed to bring about the present satisfactory condition of the undertaking. The confidence that has existed between members of your Association, and the Hydro-Electric Power Commission has, probably more than any other feature, been the secret of the success that has been attained. You must all continue to exercise a live interest in the Commission's affairs. In the future as in the past, there will doubtless be many occasions when your good efforts must be relied upon to advance the best interests of the municipalities.

May I remark that at the time I was compelled, through illness, to lay aside the less important details,

the prominent matters that were in hand, such as the work in connection with the Queenston-Chippawa Plant, the Nipigon Development, the programme respecting the development of the St. Lawrence and Ottawa Rivers, the initial steps looking to the establishment of steam plants, had been advanced as far as it had been possible, and with the constant attention of the Honourable Mr. Cooke to the affairs of the Commission, and the continued co-operation and loyalty of the staff and the whole of the Commission's organization, the affairs of the Commission have not suffered or been neglected.

Inasmuch as I am writing, it occurred to me that I might take the liberty of making a few observations with respect to one or two important matters that have recently been under public attention, and which involve issues of great moment to the citizens of the Province of Ontario.

It is unnecessary for me to emphasize to the members of your Association the vital importance of developing as required hydro-electrical energy from the remaining water powers available in the Province of Ontario so that this energy may be available to supply the municipal, domestic, commercial and industrial requirements of Ontario municipalities. On all sides there is a growing and more intelligent appreciation of the basic and intrinsic value that attaches to low-cost hydro-electrical energy. Control of this energy is coveted by many who would like to see it exported to the United States. One can hardly find fault with our neighbors to the South for desiring to have such a valuable commodity to aid in building up their industries and communities, but it is scarcely to be expected that Ontario citizens can be induced to part with a commodity so essential to their own necessities and welfare. What the municipalities of Ontario have accomplished through the Hydro-Electric Power Commission is so clear a demonstration of what can be accomplished by means of low-cost electrical energy that no justification exists for giving consideration to any proposal that would deprive the municipalities of electrical energy that could be utilized for the building up of the cities, towns, villages and rural communities of our own country.

It is only within the present month that one of the most determined and dangerous assaults ever made, involving the future welfare of the Province was under consideration by the Dominion Government. I refer, of course, to the proposals in connection with the development of hydro-electrical energy at the Carillon power site on the lower Ottawa River. The terms of the leases in connection with the development of this site were, as I have said in a pamphlet dealing with this Carillon proposal, simply scandalous. A definite attempt was made to open a door through which unlimited quantities of electrical energy, from the Ottawa River, and from the St. Lawrence River, and doubtless later on from the Niagara River would be exported from Canada to the United States. It is unnecessary here to review this situation, because I have fully covered it in the printed pamphlet

issued earlier in this month, but I do desire to take this opportunity of earnestly inpressing upon every representative interested, that the closest scrutiny must continually be made of all proposals to develop the remaining water power of our Province, including, of course, the St. Lawrence River and the remaining power that may be developed from the Niagara River.

Provincial rights must be protected to the utmost. Citizens like the members of your organization have now had an extensive experience with matters appertaining to the development and distribution of electrical energy and your close watchfulness and intelligent action, as occasion requires, will not only be a protection to the general interests of the Province, but will be a protection also to all the municipalities, —practically every one of which, for its future growth and welfare, requires that the hydro-electrical energy of the Province shall not be alienated, but that Canadian water powers shall be developed in order to supply the needs of Canadian communities.

On several occasions I have emphasized the fact that we are approaching a serious shortage of electrical energy. Every possible effort has been made to obtain from the federal Government the authority necessary to enable the Hydro-Electric Power Commission to proceed with the development of power in the upper portion of the St. Lawrence River. Our hopes in this respect have been disappointed. The desired authority has not been granted. There is no definite assurance when such authority will be obtained. The Hydro-Electric Power Commission, however, is moving as rapidly as possible to construct one or more steam-electric plants so that the industrial development of the Province need not be curtailed. It will, I know, be a gratification to you to understand that until such time as it will be necessary to generate a much larger proportion of electrical energy from steam than is at present proposed, the necessary steam-electrical energy can be produced and supplied under circumstances that will, it is believed, entail no increase in the local rates for electrical energy to consumers.

In here making a general reference to the work of the Commission, I should like to say that the operations under the Commission's jurisdiction were never in a more encouraging condition. During the past year the number of municipalities under contract has increased from 356 to 386. The amount of power generated reached in December 1924, an aggregate of over 780,000 horsepower. During the year, the capital investment in our municipal undertaking increased from $242,000,000.00 to about $263,000,000, and the annual revenue now amounts to nearly $19,000,000, and the reserves set aside for renewals and sinking fund by the Commission and the municipalities now amount to over $39,000,000. In fact no matter what aspect of the Commission's work is reviewed, it will be found that there is a very satisfactory growth.

With respect to the increased demand for electrical energy, I

should like to remark, also, that the course of circumstances bears out the representations I have before made to the effect that our Provincial markets will be able to absorb all the hydro-electric energy that our water powers can produce. I recognize, of course, that the development of some of these water powers will take many years to complete operation, but it is my belief that the energy will be required by the Municipalities and the customers of the Hydro-Electric Power Commission as rapidly as it can be made available. This has been the experience in the past, notwithstanding all the pessimistic prophecies that have been made to the contrary from time to time.

The Hydro-Electric Power Commission will use its best efforts as in the past, not only to keep you advised so that you may take the necessary action to aid in protecting your interests, but to employ all means at its disposal to keep the municipalities of the Province adequately supplied with electrical energy; and the cost of such energy in the future as in the past, will be the lowest at which such energy can be supplied.

Again thanking you for your kind invitation and regretting my inability to be present, with heartiest wishes for the continued success of your organization,

I remain,
Very sincerely yours,
(Sgd.) ADAM BECK.

Accomplishments and Future Problems of the Hydro Commission

By Hon. J. R. Cooke, Minister Without Portfolio, Commissioner, H.E.P.C. of Ontario.

(Address before Ontario Municipal Electrical Association and Association of Municipal Electrical Utilities at Niagara Falls, June 24, 1925.)

IN attempting to address this gathering that is representative of the activities of the greatest public ownership organization there is in the world, I realize full well that I am addressing an audience that is capable of criticising, in an intelligent manner, every phase of power development in this Province.

At a Convention of this kind that regularly assembles to discuss the conditions and the business of such a huge organization as this, it is only natural for you to inquire, both of the Commission and of the Government, as to the general outlook for the future, and so I will, therefore, direct my remarks not only to a brief review of the past, but also in an effort to analyze the problems of the future.

As I listened to the message of Sir Adam Beck I thought I could realize, somewhat, of your disappointment at the absence of the Chairman of the Commission, because, the history of the achievements of the Hydro-Electric Power Commission of Ontario is but the simple story of the hopes, the ambitions, and the life-work of Sir Adam Beck. Its financial success is a tribute not only to his dominating personality, but to his honesty when ranged against the great array of private capital. And I know that you are but voicing the sentiments of this whole Convention, and the people of this Province, when you expressed tonight a sincere hope for his recovery.

Now, as we assemble here tonight under the auspices of this Association, and within sight and sound of this mighty Niagara that has made possible the service you render, one can scarcely refrain from briefly referring to the outstanding principles upon which the organization of this Hydro-Electric Power Commission has been built up. In no other country in the world has there ever been developed, upon such a huge scale, an organization with such unique features as the Hydro-Electric Power Commission of Ontario, developed by the money of the people of this whole Province, but for the benefit of the people, and owned by the people. And, under its system of operation, it is returning to the Province, from the customers whom its serves, every dollar that the Province has invested in its development, and it is today a monument to its engineering staff which has successfully carried through some of the

most magnificent engineering feats performed upon the American Continent.

Let me briefly sketch for you the three most dominating features in contributing to the success of this public ownership idea in the development and transmission of electric light and power under the administration of the Hydro-Electric Power Commission of Ontario.

First of all, there was the merit of the public ownership idea itself, which recognizes this one important feature in the administration of public affairs in any country, and it is this: That the natural resources of a country belonging to all the people of that country, and should be administered for the benefit of all its citizens instead of for the personal gain of the private individual, or the corporation. Now, once that principle is admitted—and I fancy that there are few men in public life in this Province today who would dare, openly, to dispute it—there then remains to be considered the character and the ability of the men who compose the different Commissions appointed to operate these utilities, and also the Government who have to frame the legislation under which these Commissions are given power to operate.

At the very inception of the Hydro Electric Power Commission of Ontario, this Province was fortunate in having two such men as Sir Adam Beck and Sir James Whitney, the one responsible for the operation of the Commission and the other one responsibility for the legislation that gave them power to operate and to extend their activities. These two men together laid the foundations that made possible this wonderful success, until it grew from an initial load of 1,000 horse power, in 1910, that was bought from the Ontario Power Company, until today we are developing twenty-two water powers of our own and distributing almost 800,000 horse power.

Let me say to you tonight that perhaps no man who has ever been in public life in this, or any other self-governing country in the world has ever held, in the same degree, the respect and the confidence of the great mass of mankind whom he has sought to serve as has Sir Adam Beck.

Now, if you are going to ask the public of this Province to deal intelligently with the power problems of Ontario in the future, then it is necessary to place clearly before them the actual situation as it is today, in order that they may understand the necessities of the future.

I am not going to go into details tonight of this great Niagara development, because with it you are all familiar. But I would like to say this to you, that if anyone is pessimistic as to the future possibilities of this country let him take a trip over this Chippawa Development, and as he views the scene where the waters of the mighty Niagara have been diverted along the course where they will yield double the efficiency in power development, and he learns, sir, that those plans were all prepared, that this work was all accomplished under the direction and the supervision of men who are Canadian citizens by birth, and who, from their childhood, have been trained

in the schools and the universities of this Province, he is impressed with the significance that the success of this development holds for the industrial life of this Province in the future, and his confidence is strengthened in the ability of our own Canadian citizens who have made this wonderful achievement such a fine, national success.

There are just one or two things that occurred to me as the message was being read from Sir Adam Beck, and they were: In June of last year the Hydro Electric Power Commission of Ontario placed before the Government of this Province plans for the development of the St. Lawrence River at Morrisburg. These plans were approved by the Provincial Government and forwarded to Ottawa, together with the information that early in the previous year the Legislature had voted the money that was necessary to proceed with the development, and recommended to the Federal Government at Ottawa that we be allowed to proceed, and although over one year has rolled away the Commission are still waiting on a favourable reply from Ottawa.

About two weeks ago, when we realized that we could wait no longer, the Commission itself made formal application to the Provincial Government for permission to develop the Ottawa River upon the five different power sites of Rocher Fendu, Chenaux, Chat's Falls, Deschenes and Carrillon, and at once the Government of this Province gave its consent, and the engineers of the Hydro Electric Power Commission are today engaged in the survey that is necessary before we can file our plans.

But, while that is true, I want to impress upon this gathering tonight this fact: That the power problems of Ontario can never be solved to the satisfaction of the Hydro Electric Power Commission, or the people of this Province, until whatever Government may be in power in Ottawa will acknowledge and concede the rights of Ontario to ownership in the surplus waters of the St. Lawrence, and permit us to proceed with the development that is necessary in order to encourage and to maintain the industrial life of this Province.

You need make no mistake, the Hydro Electric Power Commission of Ontario are fully alive to every phase of the power situation in this country, and are determined that no effort shall be spared to conserve for the benefit of the people of this Province the full value of our natural resources in the magnificent water powers of Ontario.

Connection of Lightning Arresters

By P. B. Yates, Manager Public Utilities Commission, St. Catherines

(Read before Association of Municipal Electrical Utilities at Niagara Falls, June 24, 1925.)

IN 1908 or 1909, when R. A. Ross, of Montreal, was appointed by the Hydro Electric Power Commission to act as chairman of the various committees formed by the Engineers of the municipalities for standardization purposes, the nucleus of the present A.M.E.U., the writer, as one of his duties to the Hydro, was instructed to act as Secretary. At one of these meetings, lightning arresters were under discussion, and Mr. Ross gave his opinion about as follows:—"The action of arresters is very uncertain, but they are very necessary—for the protection of the reputation of the Engineer in charge. To install the most modern arrester is all he can do."

Twenty-five years ago, when in charge of the design of 13200 volt stations for the Switchboard Dept. of the G. E. Co. at Schenectady, I was told of a "shot" coming in on one of the 13200 v. feeders radiating from a steam generating plant and going to ground in the motor driving the air-blast fan for the transformers. With our present knowledge of lightning I would enjoy looking over the wiring scheme of that station to discover why it took the course it did.

A year or two later while overseeing the installation in Des Moines, Iowa, of an inverted rotary feeding through a 13200 v. bank of transformers the line to a 13200 v. inter-urban sub-station, I had quite an argument with the installing engineer, the point in dispute being whether the lead to the bank of arresters should be tapped off the main to the transformers, or whether the lead to the transformers should be tapped off the most direct lead to the arresters. Both of us being rather stubborn we referred the question to our head-quarters. The firm of Engineers represented by myself replied that either connection would be satisfactory to them. The Engineer of the district office of the Electrical Manufacturing Company, made a trip to Des Moines to investigate and decided in favor of the straightest possible path to the arresters—the lead to the transformers being a right angle tap through the choke coils. Lightning arrester connections have since been a hobby of mine, and I want to quote some extracts from a discussion on arresters at the Spring (1924) Convention of the A.I.E.E., reported in the January 1925 Journal. I will quote Mr. J. S. Jenks:—

> "The writer has frequently seen lightning arresters connected in such a manner that the disturbance has to reverse itself, turn very acute angles and follow a circuitous route to and through the arrester and thence to ground. Experience has proven to us that lightning

does not do such things and that lightning arresters do not have any special attraction for lightning, but that the simplest form of arrester will pass lightning readily if the lightning is led to the arrester."

Mr. Jenks then describes the conditions at some substations of the West Pennsylvania Power Company where trouble was being experienced:

"This led the speaker to believe that the lightning disturbances were following the path of the current, as laboratory tests proved that the lightning arresters would break down at about one-half the potential at which the transformers would break down, and it appeared that if the lightning were led to the arrester directly rather than to the transformers it would go to ground over the arresters and not disturb the transformers. Hence the stations were wired, bringing the line wires straight into the arresters and then making a connection from the arrester to the bus in such a manner that the lightning disturbance would be led to the arrester over a line having very easy curves and no sharp angles, while the lead from the arrester to the bus parallels directly back near the wire of the incoming lead for a distance and then proceeds to the bus in the most convenient manner."

Mr. Jenks closed with the following sentence:—

"Hence we are of the opinion that it is more essential to lead the disturbance to the arrester than it is to install choke coils."

A recent installation I have in mind has so far been fortunate but I am looking for trouble. In this case the high tension lines are dead-ended on the steel structure of the out-door station, two suspensions strains being used. A right-angle aerial tap is made from the incoming lines to the arrester bank, and between this tap and the dead-ends a second right-angle tap goes to the oil switch through the choke-coils. A "shot" coming in may follow the current past the arrester tap, may be choked back from the oil switch, and may "slop over" the strain insulators to the frame of the station. A bad shot might take two or all of the three paths open to it. I wish to emphasize the use of the word "may", but the protection of this installation can not be forecast. It may be 70 per cent. or 80 per cent. efficient but the experience of to-day leads us to believe that the feeder wires should take an unbroken course to the arresters, the angles and reversals in direction of wires being designedly in the power circuit.

We can all recall many instances of arresters on outgoing 2300 v. feeders connected by a right-angle tap, with no coils in the power circuit, the feeder wires being brought into the station by the most direct path and with graceful sweeps to the feeder switches. This might be termed "courting trouble" in the light of present-day knowledge of the subject. Earlier practice, especially in the small stations, of installing the arresters on the "home" pole, was better, or shall we say, more fortunate, in that the feeders were generally

dead-ended on this pole, and the power circuit being a tap into the station with one or two or more right-angles in it.

The increasing use of cable entrances for 2300 volt feeders is changing this phase of the question, the arresters must be installed on the line to protect the cable and the obvious method of connection is the correct one as judged by the knowledge of to-day. The line wires are dead-ended on a double-arm and continue in a curve down to the arresters, the connection to the cable being usually a right-angle tap from the main. A possible improvement in this connection is to make the power tap on the line between the two arms, reversing the flow of the current on itself before dropping to the cable end-bell.

The station is the end of the distribution system that it is most essential to protect. Any trouble here is apt to be a general one, and in the case of in-door stations, and generally all of the 2300 v. system is enclosed, any trouble may cause great damage besides a serious service interruption.

In addition the 2300 v. or 4000 v. system, built like a network over the limits of the municipality, and of late extended into the Rural Power Districts, collects the lightning discharges over such a large area that the arresters on these lines should receive more consideration than I believe is usual. Let me quote Mr. E. E. F. Creighton from the report of this same discussion:—

> "Potentials induced by thunder-clouds are independent of the operating voltages of transmission lines. Under identical conditions of induction a 2300 volt line will have induced on it by lightning as high a voltage as the 220,000-volt line. The insulation strength of the apparatus, however, is widely different. As a result, lightning arresters are not yet applied to the very high voltage lines. But somewhat inversely proportional as the voltage of a circuit is less the number of arresters used is greater."

Also K. B. McEachron's contribution:—

> "It is also important to note that the number of troubles increased as the voltage of the system decreased, and consequently the dielectric strength of the insulation decreased."

We are told that disturbances on low voltage networks during electrical storms are of two kinds, those caused by induction and those caused by a direct hit, and dependent upon various conditions the first kind may approach the second in results to service or physical damage. I would be glad to know how many others have experienced disturbances which have traveled down a line blowing the fuses of each transformer on the way. Is it not the experience of others that transformers at the ends of lines are more liable to damage than those further from the end? Those on short taps from the main lead seem less liable to trouble than those on long taps, where the trouble may originate on the tap.

When locating arresters, I liken possible disturbances to tidal waves and install the arrester on the prin-

ciple of a break-water. The far end of a primary should not drop to a transformer, but to an arrester, for the surge coming down the line seems to follow the line, not a tap from the line—continue the line past the double arm down the far side of the pole to the arrester, and tap the transformer on the near side of the pole. This is a dangerous spot and if possible it is wise to carry the primary one pole beyond the last transformer and install the arresters on the last pole.

Following this analogy, and also for reasons of economy, it would appear impractical to install arresters at each transformer on a city system, and in my opinion it is not needed. If arresters are properly installed on the various feeders, a minimum number of arresters will be required. Arresters should be located at the station end and at the far end of each feeder or tap from the feeder. The arresters on the length of the feeder if properly connected may be some considerable distance apart. The connection of these latter arresters, those not at the ends of the circuit, are those which are most commonly improperly made. The passage of the surge down the line should be impeded and if possible the surge should be diverted to the arrester.

The method which we employ in St. Catharines and which has been very sucessful in relieving the line of the surge before it has traveled very far, is as follows:—

One pole, not a transformer pole, is double-armed, and the arresters are installed on an arm below the double arm. Either side of the double-arm a strain insulator is cut into the line. Outside of these two strains, taps are brought down in an easy curve to the arresters, so that there are two line connections to each arrester.

By making these taps the same size as the line, and this can be done where the feeder wire is small, the job is complete except for the ground connection. On heavy feeders, the break in the line bridged by the arrester taps, will be shunted by a choke-coil which we make up on the job by giving a piece of the line wire a few turns around a pick-handle. This coil is fastened at the same place as the arrester tap and the insulators on the double-arm support the coil.

If a surge in either direction can get by such a lightning trap, it may properly be called "a very wise and experienced surge."

On transmission systems where taps from the line may be and usually are miles apart, the protection is placed on the taps. On a local distribution system with transformer taps sometimes on every other pole and where protection on the taps would entail great expense and sometimes considerable difficulty in the location and connection of the many arresters, proper installation of line arresters will be ample protection, and the flow of the surge ended as soon as possible.

As for the ground connection there are three good rules—make the connection easy for an unimpeded flow, use a heavy capacity ground connection, and make sure of the sufficiency of your ground. All of these rules are general practice except the last.

We have perfect results from the Ontario Power carbarundum rod device, (except that the rod would be destroyed now and then) and also with their water-barrel arrangement (except that they require constant attention and are not very practical for even the tropical winters of St. Catharines.) We still have one water-barrel installation, and two G.E. electrolytic installations on our 12000 volt distribution system, and are using G.E. oxide film arresters at our main station. All of these will and do work properly if properly connected, and one may wonder if past dissatisfaction with arresters was due, not to bad arrester design, but rather to improper connections to the arresters.

Discussion

Mr. Jos. Showalter, Canadian Westinghouse Co., Toronto: It is only in the last ten years that lightning protection and lightning arresters have been really analyzed and studied by the large power companies, and within the last couple of years they have actually measured the lightning discharge.

The manufacturers have made use of sound theoretical conclusions which they have arrived at by experiment. There remain some questions that can only be settled by actual experience, as to the best way of connecting these arresters so as to get the best results, and the questions, as brought up by Mr. Yates, are very vital. They are recent engineering problems. It is only recently that we have tried to analyze these problems. We are losing thousands of dollars' worth of equipment every year all over the country because of inadequate lightning protection, so I think you gentlemen should enter into this discussion very thoroughly and give us your experience, and let us analyze the experience, as a whole, so that central station men, distribution men, can connect lightning arresters in such a way as to cause them to be 100 per cent efficient.

Mr. S. E. M. Henderson, Canadian General Electric Co., Toronto. (*Read by Mr. Brace*). Mr. Yates' paper on this subject is a most interesting one and I wish to congratulate him on putting his principles into practice on the systems which have been under his control. Lightning, as it appears on transmission and distribution lines, ordinarily shows a very steep wave front and is therefore often referred to as being of very high frequency. As reactance is directly proportional to frequency, it is evident that a few right angle bends in a lightning arrester circuit might readily show an objectionable amount of reactance on lightning frequencies, though quite negligible as regards the ordinary commercial frequencies. Hence the importance of some of the principles laid down by the author of the paper.

Another important feature of a lightning arrester circuit, by which I mean the ground connection, the arrester itself and the connection

from the arrester to the line, is low resistance. For example, assume two such circuits of 30 ohms and 150 ohms respectively and a lightning discharge of 500 amperes. It would take 15,000 volts to force this current through the 30 ohm circuit and 75,000 volts for the 150 ohm circuit. It is quite evident that the stresses on apparatus to be protected are far more severe in the latter case than with the low resistance equipment.

Mr. Yates states that on a city system, it is scarcely practicable or necessary to provide a lightning arrester at each transformer on the line and suggests distributing arresters along the line. I cannot agree with this recommendation because the protective value of an arrester decreases very quickly as it is moved further and further away from the device to be protected. The reason for this will be seen by reference to my rough sketch showing an induced charge travelling along the line. Such a charge travels with the velocity of light or approximately 186,000 miles per second, and hence a transformer might easily be subjected to the maximum voltage of the induced charge before an arrester only a few poles away could commence to discharge.

Mr. D. W. Roper of Chicago carried on the most extensive and thorough study of lightning protection for pole transformers of which I know. He found considerable variation in conditions within the city and was unable to draw logical conclusions until he had obtained a very large number of records classified according to conditions. As a result of his investigation, his Company and many others consider 100 percent. protection both economical and desirable. A study of his reports will be found well worth while.

Many Engineers have studied lightning during the past thirty or forty years and recently most intensive studied have been made in the laboratory with the 2,000,000 volt lightning generator developed by Dr. Steinmetz and some of his assistants. The conclusions drawn from the tests and checked against observations of actual lightning are most interesting and are sufficiently reliable to be of great service to engineers connected with the problem of protection against lightning. The data is too extensive to even outline here, but those who are interested should refer to F. W. Peek's paper on "High Voltage Phenomena" presented to the Franklin Institute on Nov. 15, 1923, and his paper on "Lightning" presented to the same organization in September, 1924.

Mr. W. R. Catton, Brantford: In Brantford, we have a 4,000 volt system, and up until some years ago we tied our primary neutrals and our secondary neutrals together. We did not instal arresters on every transformer, and found after nearly every storm that we had lost a transformer. It was suggested that we separate our lightning arrester grounds entirely from the neutral. We did so, installing arresters on every transformer, grounding them separately and have minimized our lightning troubles. I believe it is due to the fact that we separated the grounds.

Mr. R. H. Starr, Orillia: There is a Bulletin issued by the American Government on lightning arresters and ground protection, published about three years ago. It goes into the matter very fully, and can be secured, free, by simply writing, I think, to the Department of the Interior at Washington. It stresses the fact that lightning arrester grounds should be kept absolutely separate from the neutral, or any other system.

Mr. Showalter: That was an exceedingly important factor in connection with lightning arresters. All manufacturers instruct that lightning arresters should be connected to separate grounds, as near as possible to the arrester itself.

Mr. Yates: Referring to Mr. Henderson's remarks, his diagram, I believe, is made on the basis of something that very seldom happens, and that is more of a direct hit on the line. I believe that the induced voltages, the induced surges, are the great majority of the line disturbances caused by lightning, and in that case I think your lightning arrester is going to work. I think everything along the line is going to work, and you are lucky if your arrester manages to do its work and get rid of enough of the charge to protect the equipment.

I notice now that I did not make my paper clear. I am not protecting the transformer so much as I am the line to which the transformers are connected, and to limit the flow of that surge along the line. It may get two or three transformers in a certain district between line arresters but I know that we have a very small number of line disturbances coming into our station arresters. They do not go along the line. They are stopped long before they get to the station with lightning arresters at station. With lightning arresters at each transformer, I believe in the case of a heavy surge coming down the line, probably every one of the arresters will do its job. My idea is to limit the area covered by that surge, by taking it to ground just as closely as possible. I will acknowledge that we lose a lot of arresters with our system of connections, because they get so much that what you can find of them after the storm is not worth repairing. I believe that we get the maximum amount of dicharge at each arrester.

Mr. Brace: Mr. Henderson was quite agreeing with Mr. Yates that the majority of the trouble is not due to a direct hit, but rather to the induced charge. What we really have in mind there is an induced charge released when the lightning strikes the ground somewhere else.

Mr. C. E. Kirkby, Brantford Twp.: I experienced a very heavy lightning discharge on a rural line, so heavy that all of the copper wire from a farmer's house to his barn, and to his garage, was completely consumed. We could not find any of it except a few pieces of insulation. The discharge burned the lightning rods on the barn into lengths of about two feet. The boxes in the barn, which were metal, were blown completely apart. There was not a window left in the man's house, having all been blown in, not from the inside of the house outward, but from the

outside inward, breaking the sash as well as the glass. We lost six meters and some transformer fuses. We lost no transformers. The transformers are protected at each pole. I feel that that was an extraordinary heavy discharge, and in my inquiries in the district I could not find that there had been any more than the one discharge. We lost transformer fuses for about a mile down the line, to the junction pole which has an arrester and fuse on it. The fuse was blown, but beyond that pole there was no damage done at all.

Mr. H. F. Shearer, Welland: I would like to ask Mr. Yates what limit he would place on the size of the ground wire down the pole.

Mr. Yates: No. 4.

Mr. Shearer: Nothing less than No. 4; does that vary with your 12,000 volt or the 4,000 volt distribution system?

Mr. Yates: No, we use No. 4, and that is independent of the size and capacity of the line.

The Distribution of Load in Domestic Electric Ranges

By F. W. Cuffe, Works Engineer, Hotpoint Works Division of Canadian General Electric Company, Limited, Stratford

(Read before Association of Municipal Electrical Utilities at Niagara Falls, June 25, 1925.)

AT first glance, the distribution of the load in Domestic Electric Ranges might not seem to be an important matter, but when we investigate the effect of unbalanced loading upon the actual operation of the Range, and domestic services in general, then we realize the necessity of giving our earnest attention to the subject.

The heat dissipated by the conventional resistor type of range heating unit approximately varies directly as the square of the applied voltage (the variation being due to the inherent properties of nickel chromium resistance material.) In other words, a decrease of 5 per cent in line voltage will cause a decrease of approximately 9.75 per cent. in the heat generated which, of course, means a corresponding decrease in power consumption and the resultant increase in time required for a heating operation, which is a very undesirable feature.

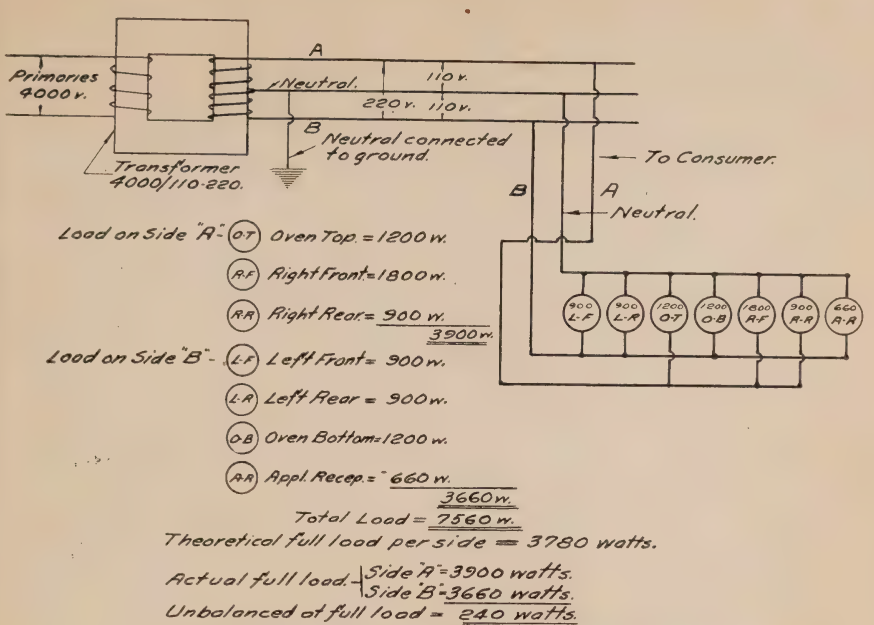
So that we will all understand the meaning of "Unbalanced Domestic Electric Services", we will refer to Fig. I which is a schematic view of a typical range service. In the drawing is shown a conventional form of step down transformer with primary and secondary windings. The 220 volt secondary is provided with a neutral wire, which as will be seen, is tapped off the windings midway between the outside leads A and B. The foregoing connections will give a potential of 220 volts across lines A and B, and 110 volts between A and B, and the neutral.

To protect the consumer against a possible shock of more than 110 volts, the neutral wire is grounded at the transformer, thereby limiting the potential of lines A and B to 110 volts, above ground, or grounded range parts, such as the body of the range, etc. It is from the above that we obtain the term "Grounded Neutral' as applied to three wire services.

By way of illustration we shall assume that the average electric range now manufactured in Canada, is equipped with four surface and two oven units, and that they are connected to the two sides of the line as shown.

(It might be well to state here, that a canvass was made of the various range manufacturers in Canada with a view to determining the foregoing, and while 100 per cent. replies were not received, those which were, indicated that the matter of balancing the range load had been given careful consideration. Our illustration, therefore, represents the average present type range "hook up").

The range units are indicated by the small circles and are connected between the neutral and lines A and B, in such a manner that when all



SCHEMATIC VIEW OF DOMESTIC RANGE SERVICE

FIG. 1

units are operating on "Full" the load on side A will be 3900 watts and on side B 3660 watts, making a total of 7560 watts.

The theoretically balanced load per each side of the line would be 3780 watts, but due to the individual wattage of the units, a closer balancing is not possible. Under average conditions, however, the domestic range is never operated with all units on "Full", in fact such is rarely the case, and as a consequence, it is only a chance that the two sides, A and B of the circuit, would be balanced even though precaution had been taken by the range manufacturers, to have the range electrically "balanced" on full load.

Ordinarily, at the time when the greatest "unbalancing" occurs, the range units most frequently used are the lower oven and large surface units. For this reason, the practice is, as shown in the sketch, to connect the lower oven and large surface units to opposite sides of the lines, thereby reducing the unbalance to a minimum, which, however, in some cases might be of considerable magnitude.

It is quite possible to connect several ranges to a circuit in such a manner that the small amount of unbalance becomes accumulative instead of offsetting itself. The net result is that the circuit becomes badly unbalanced, and, one side is

called upon to carry several hundred watts more than the other.

Should it be known that such a condition exists, the matter may be corrected by transposing some of the circuits at the consumer's service box. This is possible only after the trouble has been located, and which is, oftentimes, brought to the attention of those concerned in the form of a complaint of unsatisfactory service.

What effect has unequal loading on service or line voltage?

The manufacturers of transformers guarantee a terminal voltage regulation of 2 per cent., i.e., full load voltage is guaranteed not to drop more than 2 per cent. of no load voltage, whether one or both sides of the secondary are being loaded. It must not be forgotten that the guarantee covers only the transformer and not the service lines.

A 2 per cent. drop in voltage would not be a serious thing if same occurred at the range terminals. Unfortunately, this is not the case, and we must further contend with the I R or line voltage drop, which, in an overloaded conductor might represent several volts.

To illustrate—assume the size of copper in the secondaries is large enough to carry full load. Due to connecting the ranges in a certain manner the full load is so distributed that one side is carrying an overload and the other less than full load. the transformer as a whole is not overloaded, but the outside line, of the overloaded side will have a voltage drop in addition to the regulation drop. All ranges on the particular circuit will be effected alike—some units in the range operating at normal voltage, while those on the overloaded side, due to the excessive voltage drop, will be, what is commonly termed "slow". Should the unbalanced condition occur after sundown, it causes further complaint due to low voltage on lighting circuits.

That the foregoing undesirable conditions exist with the present three wire systems, we will agree. Our problem, therefore, is to devise a means for the elimination of same.

It has been suggested that ranges be built for operation on 220 volts, 2 wire circuits, thereby doing away with the neutral in the range, and automatically resulting in balanced range loads under all conditions.

Before we build 220 volt ranges, further consideration will have to be given to

(1) Fuses for individual units,
(2) Heating Units,
(3) Switches for individual units.

Under the heading of "Fuses for individual units", we must consider the following—

Present conditions require that the units of an electric range be individually fused, therefore, it is necessary that the fuses be of such construction that they may be readily replaced by the housewife; furthermore, they must be practically foolproof as far as the shock hazard is concerned.

For this purpose, the plug fuse readily adapts itself, but unfortunately its maximum rating is 125 volts, and consequently, could not be used in a 220 volt range.

NOTE—(Providing the range is connected to a *110-220 volt, 3 wire service*

with grounded neutral and that the range frame is also grounded, manufacturers would be permitted by the Ontario Hydro Electric Power Commission to manufacture 220 volt ranges with open coil units. It being further understood that the individual unit switches be double pole, and double fused.

Under these conditions, the potential to ground of any part of the unit could not be greater than 110 volts.)

Our only recourse is in the use of 220 volt cartridge fuses. These are undesirable from the standpoint of replacement and cost.

Plug fuses of 250 volts rating are used in some European Countries, but up to the present, same have not been approved for use in Ontario.

Under the heading of "Heating Units", we would have to consider both the open and closed type. While a satisfactory closed type could be manufactured, the small open coil unit does not readily adapt itself for 220 volt operation due to the fact that the size of resistor required for a three heat unit would be small, and consequently, would not be as rugged as the element with the heavier resistor for use on 110 volts, further, with the small sized resistor a slight overvoltage would be very detrimental.

Under the heading of "Switches for individual units", care must be exercised to see that they are adaptable for operation on 220 volt services.

In conclusion, it may be said "Unbalanced Range Circuits" are more troublesome in some communities than in others, depending upon how heavily the secondaries are loaded and how the ranges are connected to the lines.

The amount of unbalancing can be reduced to some extent by the transposition of the two outside wires of some of the customers' circuits. This would be good only for the then existing conditions, but should a service be altered, etc., the lines would again become unbalanced.

There is no doubt that ranges built for 220 volts, two wire services, would immediately overcome the difficulty. Up to the present there has been no demand in Canada for this type of range, and as a consequence, they have not been produced.

Discussion

Mr. R. J. Smith, Perth: I would like to ask Mr. Cuffe how many ranges it is customary to connect to a 10-kilowatt transformer.

Mr. Cuffe: I would not care to venture an opinion. I have known of as many as fifteen ranges on a 10-kilowatt transformer. Those conditions should not be, but they are. I presume the idea is that they won't all be operating at the same time.

The President: The demands, Mr. Smith, are about one kilowatt per range in Kitchener.

Mr. H. F. Shearer, Welland: In Welland we use split core transformers with meters on the secondaries of our transformers or banks, and taking three days readings we then proceed, if there is any serious un-

balance to balance up by either reversing three wire services or cutting two wire services to the other side of the buss. We found another difficulty with that. In the spring and fall we find entirely different conditions due to the 110 volt heater. Our problem now is to develop something to get that straightened away.

Fire Prevention

By W. H. Mulligan, Employees Relations Dept. H.E.P.C. of Ontario.

(Read before Association of Municipal Electrical Utilities at Niagara Falls, June 25, 1925.)

A recent report in the technical press states that in 1923, 2.6 percent. of the fires occurring in the United States were due to electrical origin. Strange as it may seem, the greatest increase was in new fields and is attributed to either the lack of familiarity on the part of customers with electrical service or, the prevalence of building on a minimum cost basis in order to meet the high cost of material.

We, in Ontario, can, I feel, dismiss this last cause as we are thoroughly inspected, but are you managers of utilities properly instructing your customers in the proper utilization of the apparatus you are selling them?

What protection have you on your own property? What means are you taking to guarantee your customers continuity of service? You have your stations designed, equipment installed, and lines constructed in order that service may be given with the least amount of interruption. Should a fire occur on your property, how will you fight it?

In the past few years we have investigated causes of fires and the best methods of fighting them and have found it necessary to install various types of equipment in our stations. Fires in relation to their extinguishment have been classified by the National Board of Fire Underwriters under three headings.

Class A Fires.—These may be defined as incipient fires in ordinary combustible materials where the *Quenching* and cooling effect of quantities of water or solutions containing large percentages of water is of first importance.

Class B Fires.—These may be defined as incipient fires in small quantities of inflammable liquids, greases, etc. where a *Blanketing* effect is essential.

Class C Fires.—These may be defined as incipient fires in electrical equipment where the use of a *Non-*

conducting extinguishing liquid is of first importance.

Fires of each of the foregoing classes must be attacked with the apparatus which is going to do the most good. Class A Fires (combustible materials) require *WATER*. This may be supplied from hose, pails, sprinklers or extinguishers. The extinguishers for this type of fire are the five gallon pump type or the soda acid extinguisher in its various sizes.

Class B Fires (oil and grease) require *FOAM*. This may be supplied from sprinklers or extinguishers in various sizes. It is true a blanket of gas may be obtained by discharging tetrachloride extinguishers, but it is difficult to keep this blanket of gas in its place on account of air currents created.

Class C Fires (electrical) require a *NON-CONDUCTING* liquid. This is a special fire extinguishing liquid made up to the Underwriter's Specifications and is about 98 percent. carbon tetrachloride. It is used in the small 1 and 1½ quart fire extinguishers which are hand operated, and in the 1 gal. pressure type machine.

Your requirements will thus be seen to be governed by your hazard and the type of fire you may expect. Let us consider your non-electrical properties. Your hazard here is the same as any office building, warehouse or manufacturing establishment and will pass this over, as I feel in the short time allotted to me, you would rather I would talk on the protection of the electrical end of your plant.

If your station is small and no regular attendant, install two, 1 qt. tetrachloride extinguishers. It is true no one is in the station, but fires occur more often at periods of construction or when men are working around the building.

If your station has attendants, install:—

2—1 qt. tetrachloride extinguishers,
1—2½ gal. soda and acid extinguisher,
1—2½ gal. Foam type extinguisher,
3—tetrachloride bombs,
3—sand pails.

This should be considered as a unit and is an absolute minimum. Increase the various types of equipment in accordance with local conditions the size of the station and the hazard against which you desire to protect. If your station is large install 1 gal. pressure type carbon tetrachoride extinguisher, 20 gal. soda and acid extinguishers or or 40 gal. foam type extinguishers. If you have basements or any place where smoke would be a hazard, make use of a Burrell All-Service gas mask. I specify this type advisedly, do not use any other.

The Hydro-Electric Power Commission of Ontario has issued new instructions recently re caring for fire equipment under its control. It has adopted new regulations re the requirements for the purchase and installation of its equipment. We are adopting three standard colors.

Green (H.E.P.C. standard No. 214) for tetrachloride extinguishers,
Red (H.E.P.C. standard No. 224) for foam type extinguishers,
Blue (H.E.P.C. standard No. 206) for soda and acid extinguishers.

The extinguishers which I have here have been kindly loaned to me by the Operating Dept. and I do not wish you to feel that this particular manufacture is the only one we recommend.

Carbon tetrachloride extinguishers (Green): This extinguisher is operated by pulling and pushing of the pump handle. It is most effective if used close to the fire, but may be used at a distance of twenty-five feet. If filled with any of the Underwriter's approved liquids it can be used on electrical fires. It is recommended for use in automobiles and motorboats, equip the cab of your travelling cranes. If on a fire where there is a draught, play on windward side of the fire. If the fire is in a container play stream against inside top edges of container, so that the stream may be broken up and the gas given off blanket the fire. It will not freeze in temperatures above 50 degrees below zero.

If you use this extinguisher or any other similar type take care to ventilate small rooms and confined spaces as poisonous gases which are the products of combustion are given off. Gas masks should be used.

Soda-acid extinguishers (Blue) are operated by inverting. A stream is thrown about 35 ft. When you invert, the acid and soda mix creating a pressure and you have a chemical engine which expels the water. It will freeze. It must not be used on live electrical apparatus.

Foam extinguishers (Red) are operated by inverting. A stream is thrown about 35 ft. when you invert the extinguisher. The acid in one of the solutions mixes with the soda in the other and acting similarly to the soda acid extinguisher, a pressure is created which, instead of expelling water, expells a foam mixture which will stick to any substance it comes in contact with. This foam will not burn but by blanketing cuts off the air and puts out the fire. It will freeze. It must not be used on live electrical apparatus.

Tetrachloride bombs: These are home made, and look it. They do not bear the Underwriter's label, but ask any man who has been stuck and has had to use them and you have his approval. Take a burn't out lamp bulb, immerse in a pail of tetrachloride, break off the tip and let it fill up, then clean off the opening and seal with seccotine.

After you have looked over your property and decided the number and type of extinguisher you require to suit your individual conditions, give special attention to the location of the apparatus. We recommend grouping of equipment where possible.

When your equipment has been installed, please remember it has been purchased for the sole purpose of emergency fire extinguishment. I cannot stress the word emergency too much. Any piece of apparatus which is for emergency use must be maintained in 1st. class condition at all times. Maintenance demands inspection, and to my mind inspection is the key-note of the whole problem. Unless you are prepared to give the equipment proper inspection, do not waste money on its purchase, or some day you may require it and it will not work.

In the H.E.P.C. we have adopted

the following system of inspection:

Tetrachloride (Green) 1 qt. type.

Extinguishers must be kept full at all times and be refilled immediately after use. In recharging use no liquid other than the special extinguishing liquid. This should also be used for washing out the extinguisher. Do not refill with carbon tetrachlotide.

Extinguishers must be examined every three months. Condition of pump noted for injuries due to misuse. At these inspections all extinguishers must be tested by discharging a portion of the liquid with the stream alternately upward and downward. Following this test completely discharge contents of extinguisher into a container and if satisfactory pour back into extinguisher and refill to proper level. Date should be noted on tag and initialed. All employees who may be called upon to operate extinguishers in case of fire should operate extinguishers when they are being discharged at yearly inspections.

A supply of refills must be kept on hand for immediate refilling. Care must be taken to see that refills are not exposed to air as carbon tetrachloride absorbs water very easily.

Soda-Acid Extinguisher (Blue) 2½ Gal. size.

It is recommended that extinguishers be recharged annually. Recharge immediately after use. In recharging these extinguishers all parts must be washed thoroughly with water and the water drained through the hose. This is necessary, as any acid left in tank will attack the container.

Extinguishers must be examined every three months. Remove top, see that liquids are at proper level, lead or porcelain stopples examined, and if replaced should be exact duplicates of those originally provided with the extinguishers. In replacing top grease screw thread. At yearly inspection, in addition to the foregoing emptying and recharging, all parts (including gasket and hose) must be examined for deterioration or injuries due to misuse and the opening of the hose nozzle examined to see it is not plugged. At these yearly inspections the extinguisher should be discharged and when recharged the date should be noted on tag and initialed. All employees who may be called upon to operate extinguishers in case of fire should operate extinguishers when they are being recharged at yearly inspections.

The soda solution consisting of 1 lb. commercial bicarbonate of soda must be mixed thoroughly outside the extinguisher. The liquid should be lukewarm (never hot) and put through a fine strainer before filling the extinguisher. Refills must be kept on hand so that recharging may be done promptly.

When located where continued temperatures lower than 40 deg. Fahr. may be encountered, the extinguisher should be placed in a tight wooden cabinet containing a heating unit (blue-print of cabinet supplied on application). Anti-freezing ingredients must not be mixed with the solution for depressing its freezing point.

Foam (Red) 2½ gal. size.

It is recommended that extinguish-

ers be recharged annually. Recharge immediately after use. In recharging these extinguishers all parts must be washed thoroughly with water and the water drained through the hose. Extinguishers must be examined every three months. Remove top, see that liquids are at proper level. Samples should be drawn off from both chambers and tested for expansion and quality of foam. In replacing top, grease screw thread.

At yearly inspection, all parts (including gasket and hose) must be examined for deterioration or injuries due to misuse. The strainer and opening of the hose nozzle examined to see that they are not plugged.

At these yearly inspections the extinguisher should be discharged and when recharged the date should be noted on tag and initialed. All employees who may be called upon to operate extinguishers in case of fire, should operate extinguishers when they are being discharged at yearly inspections.

The solutions must be mixed thoroughly outside the extinguisher and in exact accordance with instructions given by the manufacturer and accompanying the refills. Refills must be kept on hand.

When located where continued temperatures lower than 40 deg. Fahr. may be encountered, the extinguishers should be placed in a tight wooden cabinet containing a heating unit (blue-print of cabinet supplied on application). Anti-freezing ingredients must not be mixed with the solutions for depressing their freezing point.

Soda Acid (Wheeled Type).

Extinguishers must be recharged annually as well as immediately after use. In recharging these extinguishers, all parts must be washed thoroughly with water and the water drained through the hose.

Extinguishers must be examined once a month. Remove top, see that liquids are at proper level, lead or porcelain stopples examined, and if replaced should be an exact duplicate of those originally provided with the extinguisher. In replacing tops, grease screw thread.

At yearly inspection, in addition to the foregoing, before emptying or recharging, all parts (including gasket and hose) must be examined for deterioration or injuries due to misuse and opening of the hose nozzle examined to see that it is not plugged. The extinguisher should be discharged and when recharged the date should be noted on tag and initialed. All employees who may be called upon to operate the extinguishers in case of fire should operate extinguishers when they are being dicharged at yearly inspections.

The soda solution must be mixed thoroughly outside the extinguisher and in exact accordance with instructions on the extinguisher. The liquid should be lukewarm (never hot) and put through a fine strainer before filling the extinguisher.

Aisles at least 1 foot wider than the extinguisher must be maintained at all times and floors must be kept clear of anything which would interfere with the rapid movement of the extinguisher to a fire.

Refills must be kept on hand so

that recharging may be done promptly.

When located where continued temperatures lower than 40 deg. Fahr. may be encountered, the extinguisher should be placed in a tight wooden cabinet containing a heating unit (blue print of cabinet supplied on application). Anti-freezing ingredients must not be mixed with the solution for depressing its freezing point.

Foam (Wheeled Type).

Once a month extinguishers must be inspected. Remove top. Note level of liquids. Draw off samples of liquid from both chambers and test for expansion and quality of foam.

Make yearly inspection noting condition of hose, gaskets, etc. Grease nozzle valve. Make sure that at least one extinguisher is discharged per year at which time employees who would be called upon to operate it in case of fire would have an opportunity to operate it during test.

When test shows contents to not be of proper quality, discharge extinguisher, wash all parts thoroughly with water and drain through the hose. Recharge immediately, note date on tag and initial. The solutions must be mixed thoroughly outside the extinguisher and in exact accordance with the instructions given by the manufacturer and accompanying the refill. Refills must be kept on hand.

Aisles at least 1 foot wider than the extinguisher must be maintained at all times and kept clear for the rapid movement of the extinguisher to a fire.

When located where continued temperatures lower than 40 deg. Fahr. may be encountered, the extinguishers should be placed in tight wooden cabinet containing a heating unit (blue-print of cabinet supplied on application). Anti-freezing ingredients must not be mixed with the solutions for depressing their freezing point.

Gas Masks.

All persons who may be called upon to wear mask should be given a smoke test once a year, and should wear mask once every three months, making tests as called for in special instructions. A record of these tests should be recorded in a manner similar to that employed for resuscitation practices.

Care, Use and Inspection—Burrell All-Service Gas Mask.

Keep one mask assembled with canister attached, bottom seal in place. Keep mask in case and do not store next to radiator or heater. Rubber will last longer when stored in a cool dark place. Note the date on the canister that it is attached to mask. Canister must be renewed when hand on dial of timer has made one complete revolution or at end of one year from breaking of seal. A complete revolution of the hand on dial of the timer indicates that it has been used for two hours which is the normal life of the canister. When a new canister is attached be sure hand on dial is reset at zero.

In assembling, be sure rubber gaskets are in place.

To use: Remove adhesive from bottom of cannister, place strap holding apparatus over head. Take hold of head straps near face piece,

place chin well into mask, pull mask on to face with straps over head, the pad of the straps being at the crown of the head. Place palm of hand over bottom inlet valve of canister and inhale. If face piece collapses and no air leaks through you are now safe to enter any gaseous atmospheres encountered in our stations.

If face piece is not tight, adjust by pulling up on head strap. Adjust evenly, do not pull on one strap only. If a leak still occurs tighten union fittings at bottom and top of timer. Every three months take mask out, examine rubber in face piece, head straps, exhaling valve and hose for cracking, lack of resilience or other symptoms of rubber going dead. If any defect found, order renewals by requisition in regular manner, using chart in case as a guide. Place mask on and make tightness test.

The mask supplied you is equipped with a RED canister which will protect you against any gas found in our stations and will work in any atmosphere where there is sufficient oxygen to support life.

If through accident a canister should break down before the timer shows its limit to have been reached, you will receive the following warnings and a new canister should be immediately attached.

If any gases you can taste or smell come through in objectionable quantities, it is time to change. This break-down will be gradual.

If your breathing becomes labored, or there is a heavy breathing resistance, this indicates that the canister will no longer protect against carbon monoxide and it should be immediately replaced. If the air in passing through the canister becomes appreciably heated, this indicates a high concentration of carbon monoxide and a deficiency of oxygen, thus serving as a warning that the mask is being used in an atmosphere unsuitable for its use.

Before entering smoke or gas—

1. Examine your timer,
2. Make your tightness test,
3. See that your breathing resistance is normal.

If the foregoing instructions are carried out you should be able to safely cope with most situations. The best fire prevention is good housekeeping. By that I mean keep your premises clean. Use metal lockers. Have proper receptacles for oily waste and rags. Empty these daily. Store minimum quantities of oil, paint, and gasoline on the premises. Keep gasoline in standard approved safety cans. Do not allow smoking in storerooms or similar places. Examine your furnace pipes and chimneys once a year. At all times have a ladder on the job which has a definite location and is long enough to reach any place required and make sure this ladder is not reinforced longtitudinally with wire.

Discussion

Mr. J. W. Peart, London: I think we are very fortunate indeed in having such a speaker as Mr. Mulligan address us this afternoon on the subject of Fire Prevention. It is a subject which we are very apt to gloss over and give very little attention to, and yet in the long run there is nothing more liable to cause serious damage than a fire in a station.

The points brought out have been emphasized very clearly, and I am sure we will all reap great benefit from what Mr. Mulligan has told us.

There is one point that we have run across in connection with fire extinguishers, and that is the matter of attention. We find cases where operators have used extinguishers and have hung them up again without refilling. The result is that when we would go to use that same extinguisher it was not available. Recently, we have inaugurated a card system whereby we ask for a report whenever an extinguisher is used. This might not work out in a larger plant where fires are of more frequent occurrence, but we have been very fortunate in that respect, and we have had very few reports, so far, as to the use of extinguishers. We rely on this report to go to the Chief Operator, and he, in turn, refers it to a specially designated attendant who sees that the extinguisher is placed in an operating condition again and is ready for service.

Tetracloride bombs, as Mr. Mulligan says, are a wonderful invention. I picked that idea up from an association with some of the Commission's men once, and we have them installed in our stations, and we find that the average man is sufficiently capable to reach the seat of the fire quite conveniently with the bomb. It is very effective, and I cannot understand just why the fire underwriters will not place their approval of it. However, as Mr. Mulligan points out, we are all satisfied that it is very efficient.

Mr. H. C. Powell, Toronto: In connection with the fire hazard, I would like to ask Mr. Mulligan if the matter of cords has been taken up. There are a great many cords being used now in all sorts of places, not only in the stations for the construction men, but in the offices and homes for the use of electric fans, portable lamps and other appliances, that are not according to the rule of the H.E.P.C. In some homes, there is a regular network of portable cords, and, so far as I know, there has been no educational campaign to warn people.

Mr. Mulligan: I do not know of anything being done at present time beyond the general education which has taken place through the matter of the hazard being called to the attention of the people, the work our inspectors are doing, and the work you local managers, or superintendents, can do when you sell the apparatus. That is one of the points I stressed in my first paragraph, that you gentlemen who sell apparatus, of any description,

must impress on the people some of the hazards they are up against. Do not be afraid that you are going to scare the people from using it, because they know the benefits and are going to get it anyway. We have passed through that stage, and now that we have reached the point where we have them purchasing our apparatus and using electricity let us point out some of the things which they must do in order to get the proper use of out them.

Mr. Powell: I want, if I may, to make a suggestion, that some data be gotten up to be distributed among the operating managers, so that it can be passed out to our consumers, respecting portable cords.

Mr. C. T. Barnes, Oshawa: Mr. Mulligan spoke of the service gas mask. Is there any objection to the mask as used by the fire departments, the pure air mask? We have one under consideration, and I am informed that it gives very good service.

Mr. Mulligan: At the present, there is no gas mask on the market of a filter type that is separated from the regular hose type of mask from which you get 100 per cent protection other than the all-service gas mask. You can go to several fire appliance people and they will sell you a mask which will protect against chlorine, and all gases except carbon monoxide. In Pittsburgh, a company has the patent rights on a mask which will protect you against all gases. The Toronto Fire Department are not equipped with this mask at present. They have had demonstrations given on it, and I know they are in the market for it. To give you an idea, gentlemen, of what can be done with that mask, I went into a small garage with that mask on, and the amount of oxygen in that room got so low that the mask started to heat up. That was a warning that it was time to get out. That is a mask you can use anywhere where there is enough oxygen. They have gone through very heavy tests, and we recommend smoke tests four times a year, so that all men who are called upon to use the mask will know how to use it and be able to operate in smoke. I do not know what the mask you refer to is.

Mr. Barnes: The pure air mask. You get a line of hose ten, fifteen to twenty feet—

Mr. Mulligan: That type of mask is of no use in fighting a fire. It is all right when you are working in a trench. That is what I refer to as a hose type mask. That is all right for gas works or for working in a trench, or working in a tank car, or anything of that nature where you suck in air from the outside. A mask with a rotary blower is an improvement on that mask. When you are working with that mask, with twenty to forty feet of hose trailing with you, if you go into a fire and smoke it is pretty hard to use. You want to have your legs free. The fire departments do not use that type of mask. They use a mask supplied by one of the fire appliance companies, but recently several men have had to be carried out.

Reports

Minutes of Executive Committee Meeting

A meeting of the Executive Committee was held at the Clifton Hotel, Niagara Falls, Ont., on June 24, 1925. The meeting was called to order at 11.00 A.M. by Mr. V. S. McIntyre, President. Other members of the A.M.E.U. Executive Committee present were Messrs. C. A. Waters, H. G. Hall, W. R. Catton, R. J. Smith, R. H. Starr, O. H. Scott and S. R. A. Clement.

The meeting was called at the request of Mr. P. B. Yates for the purpose of discussing the suggestion that action be taken toward having a pension system similar to that of the Hydro-Electric Power Commission inaugurated to apply to permanent employees of the Municipal Commissions.

Messrs. John Davis, Chairman, F. J. Lowe, Commissioner, and P. B. Yates, Manager, Public Utilities Commission, St. Catharines, were present, who each advanced reasons why such a scheme was desirable.

Messrs. T. J. Hannigan and Sam Carter were present, representing the Ontario Municipal Electrical Association, through whom definite action would have to be taken.

After discussing the question at some length, the meeting instructed Mr. Yates to prepare a resolution to be presented at the joint session of the Ontario Municipal Electrical Association and the Association of Municipal Electrical Utilities to be held that afternoon, naming a Committee from the two Associations to act.

The meeting was adjourned at 11.30 A.M.

The Secretary's Report

Our records of membership of the Association again shows an increase over the previous year. For 1924 there were 143 member utilities. Of those, 13 have failed to renew their membership for 1925 while 26 new utilities have been added making a total for 1925 of 156 member utilities.

Utilities that have not renewed their membership are: Beachville, Dorchester, Goderich, Grantham Township, Kingsville, Leamington, Harrow, Otterville, Beaverton, Dundalk, Holstein, Kincardine and Penetanguishene.

The new utility members are: Aylmer, Bond Lake Rural Power District, Clifford, Ford City, Highgate, Kingsville Rural Power District, Lambeth, London Township, Port Dover, Preston Rural Power District, Queenston, Sandwich Rural Power District, Springfield, Tecumseh, Watford, Welland Rural Power District, North York Township, Bracebridge, Hanover, Meaford, Parry Sound, Ripley, Cochrane, Fort William and Wheatley.

Commercial members in 1924 totalled 38. Three have dropped out while one new company has made application for membership, making the total for 1925, 36. The application for membership comes

from Messrs. Ellis and Howard Limited, Kitchener, and it is in order that a resolution be passed by the Association electing this firm a commercial member.

The names on the Association lists are classified as follows:

Class A	—	208
" B	—	226
Associates	—	66
Commercial	—	119
Total	—	619

Respectfully submitted,
(SGD.) S. R. A. CLEMENT,
Secretary.

Committee on Accident Prevention and Health Promotion

The Committee on Accident Prevention had a meeting in Toronto some time in March when several matters were discussed relating to the work of the Committee. You all realize that the work of this Committee is mainly educational, that of educating the employees of the different Municipalities, and consequently the public. The Committee has arranged for a small exhibit of Safety First appliances, in the corridor, and Mr. Mulligan is going to give a paper later on, on Fire Prevention.

There is just one other matter which, I think, should be given the hearty support of the Association. The Committee, in discussing ways and means of educating the general public, thought that as the members of this organization are all supposedly well trained in resuscitation, they are the logical ones in their Municipalities to give training to the general public. Different organizations, such as the Boy Scouts, the Girl Guides, and so on, were mentioned, and it was decided to take the matter up with the headquarters of the Boy Scouts. This was approved of by headquarters, and I think you have all received letters asking you to keep in touch with the Scout Masters and give a talk to the boys on resuscitation. Now this, to my mind, is a wonderful opportunity to spread the gospel of Safety First and to explain to the boys what they should do in case of an emergency, and also to train them in resuscitation. I think this is one way in which this Association, or the members of this Association, can be of service to the communities in which they reside, and I would like to have the support of the Convention in this work.

Minutes of the Convention

At one o'clock in the afternoon prior to the opening session, the Association met with the Ontario Municipal Electrical Association for the Convention Luncheon, when Mayor H. P. Stephens of Niagara Falls addressed the two Associations, welcoming them to the Convention.

The opening session of the Convention was called to order at 2.30 P.M. on June 24th at the Clifton Hotel, Niagara Falls, when the President gave a short address outlining work that had been done by

the Association since its last meeting, and referring to the power situation in general in Ontario.

The Secretary then presented his report on membership for the year, which showed the total Utility members for 1925 to be 156, and Commercial members, 36, which included the application for Commercial membership from Messrs. Ellis & Howard Limited, Kitchener. The total names on the membership list was given as 619.

Moved by Mr. H. F. Shearer,
Seconded by Mr. W. R. Catton,

THAT the Secretary's report be adopted and that Messrs. Ellis & Howard Limited, Kitchener, be elected Commercial member.—
CARRIED.

Reports by the Chairmen of the various committees were presented as follows:

Papers Committee, by Mr. W. R. Catton; Convention Committee, by Mr. R. H. Starr; Regulations and Standards Committee, by Mr. O. H. Scott; Accident and Prevention Committee, by Mr. H. G. Hall; Merchandising Committee, by Mr. J. E. B. Phelps.

Mr. P. B. Yates, Manager, Public Utilities Commission, St. Catharines, read a paper—"Connection of lightning arresters". Discussion following this paper was by Messrs. Jos. Showalter, S. E. M. Henderson, W. R. Catton, R. H. Starr, C. E. Kirkby and H. F. Shearer. A hearty vote of thanks was extended to Mr. Yates for the presentation of this paper.

The joint session of this Association with the Ontario Municipal Electrical Association was then opened, presided over by Mr. C. A. Maguire, President of the Ontario Municipal Electrical Association. During this session the following resolutions were presented:

Moved by Mr. Fred J. Lowe, St. Catharines,

Seconded by Mr. Samuel Carter, Guelph,

THAT this joint session of the O.M.E.A. and the A.M.E.U. is of the opinion that a committee should be appointed to study a scheme of superannuation for employees of the many municipal Hydro-Electric Systems, with special instructions to seek the co-operation of the Hydro-Electric Power Commission of Ontario.

And further, that this Committee shall have power to secure the co-operation of the various municipal Commissions.

And that this Committee shall be constituted as follows: Mr. P. W. Ellis, of Toronto-Hydro, Mr. T. W. McFarlane of London, Mr. V. S. McIntyre of Kitchener, Mr. Wm. Childs of Hamilton, Mr. P. B. Yates of St. Catharines and Mr. T. J. Hannigan, Guelph, Secretary, with power to add to their number if necessary.— CARRIED.

Moved by Controller D. C. MacGregor, Toronto,

Seconded by Mr. Angus MacDonald, Stratford,

THAT this meeting of municipal representatives desires to renew and reaffirm our confidence in Sir Adam

Beck, Chairman of the Hydro-Electric Power Commission of Ontario, and express our hopes for his complete and early restoration to health.
—CARRIED.

In the evening at 6.30 o'clock the Convention dinner was held with the Ontario Municipal Electrical Association and presided over by Mr. C. A. Maguire. A letter from Sir Adam Beck, Chairman of the Hydro-Electric Power Commission of Ontario expressing his regret at being unable to attend, was read. The guest for the evening was Hon. J. R. Cooke, Commissioner, Hydro-Electric Power Commission of Ontario, who gave a short address which was followed by a few remarks of appreciation by Mr. F. A. Gaby.

The second session of the Convention was brought to order at 9.30 o'clock on the morning of Thursday, June 25th.

Mr. H. T. Gibbs, Canadian Westinghouse Co., gave a short address presenting the idea of holding the 1926 Convention during the same week and at the same place as the Conventions of the Canadian Electrical Railway Association and the Canadian Electrical Association are held. The president advised that this matter would be considered by the Executive Committee.

Mr. Martin L. Pierce, Director of Research, Hoover Co., Canton, Ohio, read a paper entitled "Our potential market for electrical appliances" which was followed by a talk from him on "Salesmanship". Discussion following this paper was by Messrs. W. H. Childs, G. J. Mickler, and W. R. Catton. A hearty vote of thanks was extended to Mr. Pierce for this instructive paper and talk.

At 12 o'clock noon, the Association met for Convention luncheon with the Ontario Municipal Electrical Association and the delegates were addressed by Col. A. F. Hatch, Past-President, Canadian Manufacturers Association.

The third session opened at 2.00 P.M. when Mr. W. H. Mulligan, Employees' Relations Dept., H.E.P.C. of Ontario, read a paper on "Fire prevention". Discussion following this paper was by Messrs. J. W. Peart, H. C. Powell, and C. T. Barnes. A hearty vote of thanks was extended to Mr. Mulligan for his paper.

Mr. Wills Maclachlan, Employees' Relations Dept., H.E.P.C. of Ontario, gave an explanation and demonstration of the prone pressure method of resuscitation.

Mr. F. W. Cuffe, Works Engineer, Hotpoint Division, Canadian General Electric Co., Stratford, Ont. read a paper on "The distribution of load in domestic ranges". Discussion following this paper was by Messrs. R. J. Smith and H. F. Shearer. A hearty vote of thanks was extended to Mr. Cuffe for his paper.

Mr. G. W. Austin, Manager, Electric Service League, Toronto, read a paper "Objects, Activities and Aims of the Electric Service League of Toronto". Discussion following this paper was by Messrs. B. L. Baulch and O. H. Scott. A hearty vote of thanks was extended to Mr. Austin for his paper.

The Convention was reminded of the fact that Mr. S. J. Milliken of Midland had attended every Conven-

tion of the Association except this one, he being detained at home on account of his illness.

Moved by Mr. J. E. B. Phelps,
Seconded by Mr. R. J. Smith,
THAT the Secretary write Mr. Milliken expressing the regret of the Association on account of his being unable to attend the Convention, and wishing him a speedy recovery.—
CARRIED.

A telegram from the Mayor of London inviting the Association to hold its next Convention there, was read. This was referred to the Executive Committee.

The Convention closed at 4.30 P.M. Following the final session the delegates met in Queen Victoria Niagara Falls Park for a game of baseball, between the 25 cycle managers and the 60 cycle managers. That evening at 8.30 o'clock, there was a Convention dance.

The register shows 358 to have attended the Convention which are classified as follows:

Class A	—	100
" B	—	111
Commercial	—	90
Associates	—	37
Visitors	—	20.

There were 251 at the Convention luncheon on the 24th, and 400 at the Convention dinner. 307 attended the Convention luncheon on the 25th.

Mr. S. J. Millikin Improving

The Secretary has received the following telegram in reply to a message of sympathy sent to Mr. S. J. Millikin, from the Convention at Niagara Falls on account of his illness;—

Midland, Ont., June 29,1925.
S. R. A. Clement,

Hydro-Electric Power Commission
University Ave., Toronto, Ont.
Sincere thanks for convention telegram, operation successful, making rapid recovery,

S. J. MILLIKIN.

On going to press, we learn that Mr. Millikin has continued to improve and it is hoped that before very long he will be able to be around again.

Meeting of Superanuation Committee

Pursuant to the resolution passed at the joint session of the Ontario Municipal Electrical Association and the Association of Municipal Electrical Utilities, at the Convention at Niagara Falls on June 24, 1925, the Committee named to inquire into the question of providing for Pensions and Superannuation for permanent employees of Municipal Electrical Utilities, held its first meeting at Toronto on July 3rd. The members of that Committee present were Messrs. P. W. Ellis, Toronto, T. W. McFarland, London, and T. J. Hannigan, Guelph, (Secretary)representing the O.M.E.A., V. S. McIntyre, Kitchener, P. B. Yates, St. Catharines, W. H. Childs, Hamilton, representing the A.M.E, U. and C. A. Maguire, Toronto.

(President O.M.E.A.) *ex-officio.*

The Committee discussed the question at some length with Mr. F. A. Gaby, Chief Engineer, H.E.P.C. of Ontario, and adopted the following resolution:

Moved by Mr. P. W. Ellis,
Seconded by Mr. P. B. Yates,

THAT the Hydro-Electric Power Commission of Ontario be requested to have an actuarial report made on the proposition of the Superannuation Committee of the Association of Municipal Electrical Utilities and the Ontario Municipal Electrical Association that the employees of the Municipal Hydro Systems should be allowed to join the Superannuation plan of the Hydro-Electric Power Commission of Ontario in accordance with the Act, and that the Secretary of this Committee shall be asked to obtain from the Municipal Systems such data as may be necessary for this actuarial report.

CARRIED.

All Municipal Commissions and Committees are *requested* and *urged* that the information desired of them by Mr. Hannigan, Secretary of this Committee be sent him at the earliest possible opportunity. Without this information it is impossible to make the actuarial report on which the proposed scheme will be based.

Loyalty

Several years ago it occurred to me that if I were going to accomplish anything worth while in the paper industry my college education could be very well augmented by some practical experience in the mill. Somehow or other I felt that there were a great many things about paper that could not be learned out of books or from a desk position. Strange to say, that while many things were learned about the paper process, the choicest bits of acquired knowledge were those concerning the human rather than the technical facts in the industry.

After a few months of contact with the men in the mill, my mind began to travel in pretty much the same channels as theirs and my attitude toward the company was moulded by the same forces which were moulding the rest of the workers' minds. In addition, I had worked as a union man in a union mill as well as under open shop conditions, and while my original idea had been to learn the so-called dirty end of the paper game, I found that the greatest benefit I was getting was the lesson in what goes on in the employees' minds, and why.

First I found that humanity is a pretty homogeneous mixture of good, bad and indifferent. No one of these characteristics can be attributed to any one class of society because way down underneath all qualities are evident in all groups of people.

Early in the process I had been laboring under the false impression that knowledge and hard work were the two most important factors in attaining success. I encountered certain individuals who were among the so-called white collar class who struck me as being surprisingly mediocre in these two qualities, and who, in the general estimation of the

workers were only holding their jobs on account of drag with other people higher up. Others who seemed to have these qualities were not getting away as big nor did they seem to have the confidence of helpful support of management. For a long time this condition formed a very perplexing question until the answer came to me like a burst of sunshine and I must frankly admit that my solution to the question was not altogether original but arrived at with the help of one of the men in the mill. A certain man was under discussion at the time, and my friend in the mill said that the only reason they "hung on to that fellow" was that they knew he was working in the company's interests, could always be depended upon to do exactly as he was told, and was not so ambitious that he was trying to run every other job along with his own. In other words, he was loyal to the company, and the company knew it. If anyone had told me years ago that the big key to success was loyalty, I probably would have called it bunk and labelled my informant as a sap.

Since those days I have had a chance to superintend a paper mill and analyze the relationship between employer and employee from the other side. Having viewed the problem from both sides, I am frank to admit that neither side is perfect. There is certainly a need for better understanding of the other fellow's condition, more loyalty, more courtesy, more openmindedness, more sincerity, and a more immediate realization of the fact that although in every community certain members are "getting away with murder", the general law is that virtue will be awarded, and that the devil will get his due.

The thoughts underlying all the foregoing have been expressed from the beginning of time by various people in various ways, and I presume there will always be those who call it bunk, but certainly the keystone which holds up the whole structure of man's relations with his fellows is loyalty in one form or another, and whether it be in industry, commerce publicity, or social life, loyalty to a trust pays the biggest dividends.—*Pulp and Paper Magazine.*

List of Electrical Devices, Material and Fittings

Approved by the Hydro Electric Power Commission of Ontario in June, 1925

Appliances

Renfrew Electric Products Limited, Renfrew, Ont.

"Majestic" Mantel Grates, Cat. Nos. 38, 39, 41 and 46.

"Majestic" Air Heaters, Cat. Nos. 1, 2, 7 and 8.

"Canadian Beauty" Air Heater, Cat. No. 4.

* * * *

HEYES AND HARROP (Submitter), 782 King St., W., Toronto.

HUBBARD PORTABLE OVEN COMPANY OF CANADA LIMITED (Mfr.), 782 King St., W., Toronto.

"Hubbard" Automobile Electric Water Heater.

* * * *

BURKE ELECTRIC COMPANY, 12th and Cranberry Sts., Erie, Pa.

Arc Welding Machines.

* * * *

THE WILLIAM CAMPBELL CO, Alliance, Ohio.

Electric Range.

* * * *

CANADIAN RADIANT ELECTRIC COMPANY, Grimsby, Ont.

"Radiant" Hot Plate.

"De Luxe" Electric Upright Toaster.

* * * *

THE NELL & TOM ELECTRIC TOASTER CO, (Submittor), Grimsby, Ont.

CANADIAN RADIANT ELECTRIC COMPANY (Mfr.), Grimsby, Ont.

Electric Hot plate.

* * * *

J. L. VOKES & SONS, 106-7 York St., Toronto.

Mantel Type Air Heater, Cat. Nos. 41, 42, 43, 51, 52, 53, 82 and 92.

* * * *

PEERLESS MFG. CO., 122 Wellington St., W., Toronto.

"Peerless" Floor Polisher.

APEX ELECTRIC MANUFACTURING CO., LTD., 102 Atlantic Ave., Toronto

"Rotarex" Electric Washing Machine.

* * * *

ELECTRIC STEAM RADIATORS, LIMITED, 101 Federal Bldg., Toronto.

Electric Air Heater–Radiator Type

* * * *

THE CANADIAN BLOWER & FORGE CO., LTD., Kitchener, Ont.

Motor-operated Blowers, Types 2E, 2EH, 3E.

* * * *

BEACH FOUNDRY LIMITED, Ottawa, Ont.

"Beach" Electric Range, Cabinet type, Style E204; Low Oven type, Style E103.

* * * *

CUNNUNGHAM FURNACE & MACHINERY CO., LIMITED, Sarnia, Ont.

Enamelling Oven, Type L.

Electrically-heated Furnace, Type M.; Carbon Type Furnace, Type H.

* * * *

*HURLEY MACHINE CO., 22nd. St. and 54th Ave., Chicago, Ill.

"Thor" Electric Ironers, Cat. Nos. 75, 30.

* * * *

*PERKINS ELECTRIC LIMITED (Submittor), 21 Wilton Square, Toronto.

MAGNAVOX CO., THE, (Mfr.), Oakland, Calif.

Electric Air Heaters, Portable type, Type H-1, H-2, H-3, H-3-S Model B.

Electric Air Heaters, Stationary type, Type H-2-W-8.

* * * *

*CIRCLE F. MFG. CO., 10 Prince St., Trenton, N.J.

Medium Base Sockets, (as listed on Underwriters' Laboratories card dated May 5, 1925).

* * * *

Fittings

DESHAW Co, LTD. (Submittor), 325 Howe St., Vancouver, B.C.

THE NIKKO Co., (Mfr.), Yokohama, Japan.

Current Taps "De-Lite".

* * * *

MARR W. P., 102 Russett Ave., Toronto.

Wire Connectors "Marr".

* * * *

*BEAVER MACHINE & TOOL Co., Inc., 625-45 N. Third St., Newark, N. J.

Fuseless Attachment Plug, Cat. No. G-1.

* * * *

*BENJAMIN ELECTRIC MFG. Co., 120-128 S. Sangamon St., Chicago, Ill.

"Ben-ox" Medium Base Sockets. Metal shell.

Keyless, Cat. Nos. 4700-03 incl., Base only, Cat. No. 4724, Shell only, Cat. Nos. 4726, 4727.

Pull, Cat. Nos. 4706-09 incl., Mechanism and shell without base, Cat. Nos. 4787-90 incl.

*HART & HEGEMAN MFG. Co., (Submittor), 342 Capitol Ave., Hartford, Conn.

PAISTE Co., H. T., (Mfr.), 32nd and Arch Sts., Philadelphia, Pa.

Fuseless Attachment Plugs, Cat. Nos. 430, 1400, 1405, 1423, 1426, 1427, 1458, 1465. "Paiste" or "H. & H.".

* * * *

*CHASE-SHAWMUT Co., Newburyport, Mass.

"Shawmut" Cartridge Fuse Cutout Bases, Cat. Nos. 2067-72 incl., 2077-88 incl., 2101-02, 20675, 20685, 20695, 20835, 20845, 20875, 2073-76 incl., 2095-96, 20735, 20745.

"Shawmut" Cartridge Enclosed Fuses—renewable.

"Shawmut" Cartridge Fuses.—non-renewable.

"Shawmut" Ground Clamps, Marking C-S Co.

"Type C." Marking C-S Co.-C.

* * * *

Miscellaneous

*L. & N. Co., THE, LTD., St. Johns, Quebec.

Flexible Tubing.

* * * *

*These devices are under the Underwriters' Laboratories re-examination or label service.

Re. Municipal Populations

To enable The Bulletin to give as nearly as possible the correct populations of the Hydro Municipalities as shown in the lists on the inside of the cover, it would be of considerable assistance if the Municipal Officials advise of any corrections that should be made.

—Editor.

268
1

THE
BULLETIN

Published by
HYDRO-ELECTRIC POWER COMMISSION
of Ontario

190 University Avenue
Toronto

Subscription Price $2.00
Per Year

An Appreciation of Sir Adam Beck,

Late, Chairman, Hydro-Electric Power Commission of Ontario

By Hon. J. R. Cooke, Commissioner, on behalf of himself and the Employees of the Commission.

THE staff of the Hydro-Electric Power Commission of Ontario desire to express their deep sense of sorrow and loss experienced on account of the death on the fifteenth of August, 1925, of their highly-esteemed and beloved Chairman, Sir Adam Beck. As a member of the Commission and a colleague of Sir Adam Beck, I also express my own deep sense of personal loss.

Owing to the unity of effort and co-operation that has characterized the relationship between the Commission and its staff, I am especially pleased to associate their expression of homage to the memory of our late Chairman with my own.

It is over two years since I became associated with the late Chairman. I had previous knowledge of the underlying principles upon which the Commission's work was conducted as expressed in the Provincial legislation, and was, moreover, in genuine sympathy with those principles and with the municipally-owned hydro-electrical undertaking as a whole. Immediately upon my closer relationship with the Commission, I was much impressed with the jealous care manifested by Sir Adam Beck to ensure that in the administration of the Commission's affairs there should be no departure from the basic principles of public ownership upon which the Commission's superstructure and general administration had been founded. Sir Adam Beck was unusually sensitive in his detection

of whether policies or individual views were in accord with the objects of public ownership so dear to his heart. I found myself in fullest accord with the Chairman and throughout the whole period of my intimate association with him, I received nothing but the best of sympathetic co-operation with respect to the Commission's work, while on my part there was no man who I felt was better qualified to receive my whole-hearted and complete support. Satisfactory appraisement of what constituted basic policies, foresight with respect to what was essential to their consummation and readiness to delegate to others the performance of essential details were qualities so fairly balanced in Sir Adam Beck's direction of affairs that words cannot express the loss it is to be deprived of his wise counsel and truly sympathetic co-operation.

Sir Adam Beck had unbounded confidence in his staff. The harmony that has existed between the Commission and its staff is evidenced by the fact that although the Commission has been operating less than twenty years, yet the average length of service of its administrative heads is over fifteen years. I know that Sir Adam's own feeling with regard to the satisfactory perpetuation of the Commission's work rested chiefly in two main features; the one that the broad basic principles of public ownership should be strictly preserved and kept free from political influence or control, and the other that the staff of the Commission should always be constituted on the basis of intrinsic qualification to perform their duties and that they should be untrammeled in the administrative exercise of their respective tasks.

Much has been, and much more might be, said regarding the qualifications of Sir Adam Beck and the wonderful achievements that have been accomplished through his foresight and untiring effort. The staff of the Commission, however, will, I believe, always regard our late Chairman rather from the viewpoint of his personal relationships with them.

In the first place, the members of the staff recognized that in having, in the year 1906, placed on the Statute Books of the Province the Act known as The Power Commission Act, there had been embodied the fundamental doctrines upon which the Commission's whole undertaking was based; that these doctrines were an expression of the vision and genius of Sir Adam Beck; that with relatively minor legislative changes the foundation of the Commission, as originally laid, remains today;—and this in spite of all the opposition that has been created for its destruction. No one, unless possessed with the masterful, dominating spirit and persevering enthusiasm of Sir Adam Beck, could have successfully championed such difficult and novel measures through the legislature.

Sir Adam Beck's first and constant concern has been that the work of the Hydro-Electric Power Commission should contribute directly and to the fullest possible extent to the growth and welfare of Ontario municipalities. There was no proposal made which he believed would result in benefit to the municipalities that did not enlist his heartiest co-operation and the application of his indefatigable energy. Sir Adam had unbounded and sincere faith in the intrinsic merits of the municipally-owned undertaking. His statesmanship and diplomatic skill were employed in directing the whole public-ownership enterprise and in preventing interference from any quarter that might lessen the progress and effectiveness of the programme he was directing.

Sir Adam Beck was an eloquent and forceful speaker with a magnetic personality. Few men had his ability so quickly to obtain the sympathy and confidence of an audience. By his mode of speech and manner, he was able to impart that which commanded attention and respect for his utterance. He was a keen and intelligent debater, with a ready wit often turned with telling effect in the public interest. He courted the expression of opinions from those who, he knew, entertained views at variance with his own and, not infrequently, took means to evoke from others antagonistic arguments in order that he might better appraise the views they held.

Sir Adam was particular regarding details and in his administrative and personal habits he was scrupulously orderly and desired that others exhibit similar qualities.

Now, these and other features were well known to the staff, and more particularly to the administrative heads of the various departments. All knew of the intrinsic understanding possessed by their Chairman with respect to the aims and objects of the Commission, and, consequently, it has ever been the pleasure and satisfaction of all members of the staff to contribute to the utmost of their ability in the carrying out of any wish expressed by their Chairman.

Sir Adam exhibited an earnest desire to keep all members of his staff in a contented and happy frame of mind, and in the social functions, games or other outside activities of the staff he was regarded as the moving spirit. All such activities received his whole-hearted sympathy and support and whatever of spare time he could bestow to further them.

The staff, it is true, knew that Sir Adam was a man of strong impulses, rather brusque in manner, but there was probably no member of the staff who did not appreciate the kindliness of heart and disposition that lay beneath this exterior. Sir Adam was always ready with a helping hand; solicitous for the unfortunate, and thoughtful of the comfort and welfare of those associ-

ated with him in his great undertaking.

Those members of the staff who had been through the great stress and opposition experienced by the Commission in the earlier years of its work understood best the extent of the self-sacrifice, devotion to duty, masterful fearlessness and resourcefulness of Sir Adam Beck, and these members are, perhaps, best able to interpret the affection they entertain for him. But while there is this more intimate understanding on the part of some, there, to-day, is found throughout the whole staff of the Commission a genuine and profound sense of respect, admiration and unbounded loyalty for their late Chief and leader.

Anyone who considers the general day-in and day-out working of the Hydro-Electric Power Commission must realize that there is a something which has held and which holds this efficient organization together and which has caused it, in the public interest, to function so smoothly as a complete operating entity. It is recognized that an organization is largely a reflection of its guiding head, and I have no hesitation in affirming my personal conviction that it has been the singleness of purpose towards the public, the absolute integrity, the foresight and the determination to persevere at all costs in carrying out the great municipally-owned undertaking for the benefit of the people as sponsored throughout his public career by Sir Adam Beck, that has constituted the inspiration of every member of his staff. I know of no organization where there exists greater loyalty in support of the responsibilities entrusted to it.

There is no doubt that Sir Adam Beck's years were shortened by the excessive and often very unreasonable demands made upon his time and strength through the repeated attacks upon the work of the Commission by those antagonistic to public ownership. Public investigation consequent upon such attacks involved long hours of toil, and stress in addition to the pressing regular demands of the Commission's work. Sir Adam was reluctant that any attack launched against the Commission having within it the possibility of future trouble for the Commission should remain unrefuted, and one by one as these attacks came up, Sir Adam effectually dealt with them. There has been no time in the history of the Commission when its various operations have been so thoroughly vindicated and when the injustice of all the attacks against the Commission has been disclosed and disposed of to the satisfaction of the public concerned, as during the last few years of Sir Adam's life. Sir Adam leaves his successors a clean slate.

In conclusion, I should like to add—and this also was a feature that the Chairman always sought to impress upon the administrative heads of his staff—that the future of the Commission is a matter of prime importance, for which ade-

quate provision must always be made. Having achieved any particular result, Sir Adam was ready to forget the things that were behind and to press forward towards the accomplishment of what was required to meet the future domestic, commercial, industrial and municipal needs of the citizens of the municipalities of the Province. During the long months of his illness, Sir Adam's mind was constantly engaged upon considering how best to provide for these future requirements. His desires and ambitions in this respect have been expressed to those who have been in closest personal touch with him. It is the earnest desire of the staff and of the Commission to continue to preserve the traditions and objects of public ownership. All who have been associated with Sir Adam Beck will never forget the confidence inspired by his leadership, nor the loyalty stimulated by his example as a faithful public servant.

As is known, there are relatively few persons with whom the Chairman was personally intimate. The larger proportion of these were those associated with the work of the Hydro-Electric Power Commission. Apart from his own immediate family circle, it is certain that there is no place where Sir Adam Beck will be more missed and his memory more cherished than in the hearts of the members of his staff.

Salesmanship

By Martin L. Pierce, Director of Research, The Hoover Co. Canton, Ohio.

(Address before Association of Municipal Electrical Utilities, at Niagara Falls, June 25, 1925).

I. Salesmanship is both a science and an art.

THERE was a time when business men were quite sure that salesmen were born and that training played very little, if any, part in their development, but today we know that salesmen are made by training and education just the same as physicians, lawyers or school teachers. Practically every outstanding business concern today has set up some definite programme for the developing and up-grading of their sales force.

2. It is an art because no amount of instruction will make it possible for a salesman to bring in a large volume of business until he has had sufficient actual practice in selling to be able to use skilfully the information that has been given him. This, however, is true in every profession and salesmanship certainly today is recognized as a profession.

3. The sale is made in the mind and not in the pocket-book. For that reason salesmanship deals fundamentally with mental laws and processes. There are definite steps or stages in the sale just as there are various processes when manufacturing an article for sale. The salesman must begin his work by a proper investigation of the prospect, being sure that his commodity or service is actually needed. After preparation, he also learns how the service will best fit in with the prospect's business or personal need. When the sale is actually started the salesman must first secure attention. Then interest, next a desire to buy, after this decision to buy and in the last place, satisfaction. No sale is complete until the prospect is in possession of the commodity and is convinced that his money has been well spent.

II. Salesmanship today means a review of fundamental selling ideas.

1. A salesman must know his merchandise. This does not mean simply the mechanics of the commodity but rather the uses to which it will be put. In fact, all large sales records are made by selling ideas and not material. A lumber prospect is not interested in flooring and shingles, but in a home or an investment. Electric appliances were never sold in large volumes until the manufacturers of washing machine commenced to talk about the finished product—clean crisp clothes. An electric refrigerator manufacturer today speaks of good food which is the result of constant temperature. A furniture dealer sells harmony and beauty in the home, not furniture and drapes. The salesman must

CONTENTS

Vol. XII. No. 8
AUGUST, 1925

know that his commodities are better than others offered at a similar price. He must know the exclusive features of the merchandise he is selling. He must know what the special values are which they have for the people who are buying them. Furthermore he should have an equal amount of information regarding merchandise being sold by his competitors.

2. The salesman must also know himself. Every man has his strong points. Conditions in the life of the salesman are thought-made. The salesman who will, can very easily transform himself by keeping his mind on the traits of character that he needs to develop. A man only becomes a salesman when he stops complaining and whining about conditions, or hard luck, and commences to search in his own life for the hindering circumstances that are interfering with his success. If a salesman really desires success he will hold constantly before him a proper aim or objective, and consistently make progress towards it.

3. Again, a salesman must likewise know trade conditions and human nature. When a prospect tells him that he is waiting for prices to come down, he should be able to give immediately his reasons for believing that this is an opportune time to buy. If the customer questions the wisdom of making the investment, the salesman must be able to give facts and figures that justify the expenditure. Today, business is knit together so closely that it is impossible for a salesman to know his own business well unless he goes to the trouble to study general business conditions, and the conditions that exist in parallel or related industries. Certainly a flour salesman must know the conditions of the wheat crop.

III. There are a few outstanding "Don'ts" that Salesmen must learn.

1. Don't try to win your sales with arguments. Sales history is filled with the experience of salesmen who have won arguments but lost sales. It is not necessary to attempt to give a direct answer to the prospect's objection. If the objection raised by the prospect is an important one, it can be answered simply and directly. The salesman dignifies the objection with too much e

planation. He only rivets it in the mind of the prospect. Usually the salesman gets farther ahead by simply stating, "I will get to that in a minute" and then going straight ahead with his explanation of the details of his sales talk. Never let the prospect's objection lead you to take a position of positive disagreement, even if in your own mind you are convinced, and know, that he is wrong. We usually buy from our friends, and our friends are sympathetic with us in both our convictions and our prejudices.

2. Don't take too seriously pretended objections that are raised by the prospect. Many a man will tell you that your prices are too high when, as a matter of fact, he hasn't money enough to build the kind of a house or factory that you are suggesting. Today, many men are offering all kinds of objections to the arguments presented by automobile salesmen when, as a matter of fact, they like the car, and would buy it, but their wives insist that they buy another make. When the salesman is led afield by pretended objections all of his sale efforts are spent in the wrong direction. When the salesman ignores and passes by these pretended objections he is apt, very quickly, to come face to face with the real objection that he must overcome. When this has been done, every word, every argument, every demonstration will lead directly to the sale.

3. Don't slur your dominant selling points. One of the easiest things for a prospect to do is to nod his head in approval of sales argument even when he does not understand what the salesman is trying to get across. The salesman may have a number of worthwhile reasons why the prospect should buy his merchandise, but they will amount to little or nothing unless at least one or two of the dominant selling arguments are clearly and distinctly understood by the prospect. Get this across in such a clear and forceful way that the prospect is compelled to understand. The salesman must decide in advance what his dominant selling points will be, and he should know the ones that carry the greatest amount of conviction. To-day thousands of homes are being built out of substitute materials simply because lumber salesmen have not mastered their dominant selling arguments. Not long ago I was in a community where it seemed everybody was building brick or tile stucco houses. My investigation showed that the chief reason for this was that systematic propaganda was put out showing the enormous cost of getting frame houses painted. The lumber industries seem to have done nothing to counteract this propaganda.

IV. Success factors in Salesmanship are as definite as mathematics.

1. The salesman must assume a social and economic responsibility. Much praise must be given to the inventor, but no invention has ever contributed anything to civilization until some salesman put the idea across, tearing down the objections that were offered to it, turning aside prejudices that were directed at the

new idea and exposing the inefficiency of the older methods. It would be hard to find any single idea that has carried civilization forward that has not been popularized and put over by salesmen. All roads of commercial progress are laid out and opened up not by inventors, not by production managers, not by Boards of Directors, but by salesmen. These facts dignify salesmanship and the salesman and put him in the first rank of the world's constructive thinkers and doers.

2. The salesman must be willing to give serious thought to the development of his personality. Men act as they think. The salesman's thoughts affect his customers. A real salesman is also interpreted by his manner and expressions. Personality is, without question, the greatest factor in salesmanship, and personality comes from thoughts, it does not come from the clothing store, or the barber shop, or the shoeshine parlor. This means that the salesman should be as human as possible. It was never intended that a salesman should be a catalogue or simply a piece of printed publicity material, but he must always be the kind of a man that he likes to do business with. Men buy more merchandise when arguments give place to more emotional appeals. The hardest, strongest argument should be aimed at the heart of the man and not at his head. He should remember that when he makes a man like him it is always easier to prove the value of his merchandise.

3. Success in selling, in the last analysis, is a question of percentage. The average Life Insurance salesman knows that out of every ten men interviewed one will be interested in life insurance. The vacuum cleaner salesman knows that out of every ten home demonstrations he makes he should sell four machines. The automobile salesman knows that out of every twenty-five homes canvassed he will get one live prospect for his product. The department store manager knows that out of every hundred people coming into his place of business forty-five will buy merchandise. In every case the number of sales that a salesman will make during any month is a very definite percentage of the total number of calls that he has made. If only half the number of calls were made this month that were made last, the salesman knows in advance that he will only make half the amount of sales.

4. The important thing for the salesman to find out is what percentage of his calls is he closing—are other salesmen in the same line doing any better? If a lumber salesman can make fifty calls a week and is selling one bill of merchandise for every ten calls made, he will realize the loss when his calls drop down to twenty-five a week. When you definitely know the percentage of sales you are actually making from calls you will develop an urge to raise this percentage. When every man becomes actively engaged in competing with himself, he has entered a contest that is mighty hard to stop.

Re 1926 Hydro Calendar

Elsewhere in this issue is to be found a description of the new 1926 Hydro calendar which is well worthy of careful study. On account of the successful venture in issuing the 1925 calendar the Commission has acceded to the requests of a number of the Municipalities and gone ahead with the issuing of another for next year but with many improvements and the actual samples which are being sent to every Municipality will speak for themselves.

Of the 1925 calendar over 300,000 were distributed and there have been many very complimentary remarks passed about the appearance and usefulness of the calendar and also expressions of appreciation from Hydro customers at the thoughtfulness of the Municipalities in presenting these calendars to them.

The Commission has gone one better this year by producing a colored calendar with a little higher quality of art work at a slightly higher price, but we believe that this calendar will be improved to a much greater extent than our first attempt and every Municipality in the Province should co-operate by presenting one of these calendars to every one of its customers.

Our Potential Market For Electrical Appliances

By Martin L. Pierce, Director of Research, The Hoover Co. Canton, Ohio.

(Paper read before Association of Municipal Electrical Utilities at Niagara Falls, June 25th, 1925.)

DURING the past six months, I have visited over one hundred cities and towns in the United States and Canada in which The Hoover Company has dealers or resale organizations. While visiting these towns, I have made it my business to check as carefully and fully as possible regarding the activities of our own organization and dealers as well as other companies in their distribution of appliances. These visits, conferences and investigations which I have made have brought me face to face with the following convictions regarding the market, and the responsibility for the distribution of electric appliances.

I. *That the appliance industry today is steadily losing ground in relation to its potential sales possibilities in the electrified home.*

1. Figures, assembled by an independent organization from manufacturer and trade association sources and regarded as a fairly accurate compilation, indicate that only 44 of each 100 wired homes in the United States were equipped with electrical cleaners of any and all makes on

January 1, 1924. This compilation was made in the United States, but my personal investigations in Canada would lead me to believe the same figures hold true in this Dominion. This distribution, of course, was not spread evenly over the country but was above the average in the Middle Atlantic states—New York, New Jersey and Pennsylvania—and very much below average in the group comprising Alabama, Mississippi, Tennessee and Kentucky. The indicated remaining market for electric cleaners is 56 per cent. of the present number of wired homes. The daily production of this household necessity, however, is not yet equal to the daily increase in wired homes and the present market is therefore increasing with each passing day. Saturation is nowhere in sight, nor will it be for a long time to come. The cities and the sections where the development is best are, almost without exception, those where Central Stations are active merchandisers. It, therefore, seems proper to assume that high development is, in a large measure, the result of aggressive and successful merchandising by Central Stations.

2. It is only in the sale of electrical household equipment that there is a continual rapid increase year after year in the actual number of people who buy in every town—and this is because more homes are wired and begin to use electricity. Do you realize what this means to the merchant who sells electric appliances? It means this—Last year the electric light and power customers connected to their service lines 2,185,000 new customers. On an average, in cities of 60,000 there were in 1923 about 1800 homes that came new into the market. Of the homes that are already wired—

- 23% have no electric irons,
- 63% have no vacuum cleaners,
- 62% have no electric fans,
- 73% have no electric clothes washer,
- 85% have no electric heaters,
- 87% have no electric toasters,
- 95% have no percolators,
- 98% have no ironing machines,
- 99% have no electric dish washers.

Please bear in mind these are average conditions. There are, no doubt, isolated cases where a better saturation has been obtained.

3. The total sales of electrical household appliances have never yet been large enough to completely equip even the new homes that were wired each year, let alone the others already using electricity. In 1920 only 25 per cent. of the appliances needed to completely equip all the connected homes were in use. In 1921 it had fallen to 24 per cent., in 1922 to 22 per cent., in 1923 it fell to 20 per cent., and in 1924 it fell approximately to 18 per cent. Only one-fifth of the appliances needed in these homes had been sold. The market is actually growing faster than it is being supplied—and the rest wait.

II. *That in towns where the central station merchandises electric appliances, the appliance business of the dealers is increased.*

1. On a survey taken in a city of 250,000 by the "Electrical World," the following replies were given by various dealers handling electrical

appliances. Dealer "A" did not feel that the power company was in any way trying to "hog" the electric business by offering long term payments, as he considers this a good means of introducing appliances to the trade. Dealer "B", who carries a wide variety of appliances, states that the local central station had accomplished a great deal in the introduction of household devices. Dealer "C" makes a practice of carrying well-known makes of appliances. He states the central station is performing a valuable service to the dealers in exercising its policy of time payment and advertising electrical merchandise. Dealer "D" says that he characterized the central station as the backbone of the appliance business in the city and credited it with a great deal of promotion work. Five contractor dealers were unanimous that it would be detrimental to the total volume of appliance sales were the central stations to retire from the field.

2. It is being rapidly demonstrated that sales of electric merchandise and appliances by the central station, and at fair prices, are followed by larger and profitable sales of kilowatt hours to existing installations. The consequent increased popularity of electric service stimulates the wiring of homes not now equipped electrically. This means that many new customers are added and that the public is better satisfied because of a more adequate service.

Legitimate competition and fair trade practices undertaken in a spirit of "Live and Help Live" are proving most potent stimulants of growth. This has been thoroughly proven in Cincinnati during the past two years where the total number of homes being wired monthly, now that the electric company is fully in the game, is approximately ten times what it was when the contractor had the field to himself. The contractor himself is not getting better but fairer prices and is now doing four to five times as much as when he had the field to himself. Recent experiences in southern California, where the Edison Company has been obliged to re-enter the appliance field in the sale of ranges, water heaters, shows a similar condition producing more satisfactory results for dealer and central station alike.

These figures indicate quite clearly that it is not so much the "accepted merchandise" that requires the central station man's attention as the promotional or pioneer appliances such as the range, the portable household electric cooker, the home refrigerating machine and other appliances which the householder does not yet understand and appreciate. These promotion devices are the ones that should interest the central station man because they are susceptible of producing seven or eight times as much income as will the whole list of "accepted merchandise."

RELATIVE GENERATING STATION CAPACITY VALUES AFTER DIVERSITY ALLOWANCES, EARNING PRESENT AND EXPECTED, ALSO SATURATION VALUES FOR RESIDENCE CUSTOMERS FOR VARIOUS HOUSEHOLD APPLIANCES.

Edison 1922 Survey Values (Annual)				Effect on General Station, Etc.				
Standard Mdse. Devices		K.W.H.	Average annual income per appliance	***Estimated Number of devices to equal one Kw. at gen. station on yrs. peak	Resultant annual income per Kw. of demand at gen. station	Average Number of devices per 1000 customers — Now	Average Number of devices per 1000 customers — Ultimate	Annual Income value of remaining business per 1000 customers
1. Flat Irons	Houses.	58@10c	$5.80	20	$116	800	1000	$1.160
	Apts.	45	4.50					
2. Vac. Cleaners	Houses.	6@10c	.60	200	120	500	800	180
	Apts.	4						
3. Washing Machines	Houses.	21@10c	2.10	50	105	300	750	945
	Apts.	20						
4. Toasters and Toaster Stoves	Houses.	20@10c	2.00	60	120	200	800	1,200
	Apts.							
5. Percolators	Houses.	19%10c	2.00	60	120	60	660	1,200
	Apts.	22						
6. Sewing Machines	Houses.	7@10c	.70	200	140	50	500	315
	Apts.	2						
7. Fans	Houses*	8@10c	.80	100	80	50	400	280
	Apts.	8						
8. Curling Irons	Houses.	2@10c	.20	500	100	40	540	100
	Apts.	3.5						
9. Radiators	Houses.	29@10c	2.00	50	100	40	440	800
	Apts.	12						
					Standard Mdse. Total			$6,180
Promotion Devices (The following not included in Edison Surveys)								
10. Range	Avge.	1600@ 4c	64.00	**1.33	**85	10	210	12,800
11. Refrigerator	Avge.	700@ 4c	28.00	12	336	5	600	16,800
12. Fireless Cooker-Elec. Stove	Avge.	360@10c	36.00	4	144	5	300	10,800
13. Dish Washer	Avge.	45@10c	3.00	30	150	1	250	750
14. Water Heaters		1800@ 3c	54.00	1.33	72	0	100	5,400
					Appliance Total			46,550
Domestic Lighting Possibilities								
15. 100 Watt Kitch. Lts. Units at 50 w. increase each		37½@10c	3.75	40	150 0.0	500	1,875	
16. Portables and other misc. ltg.—100 w. added load per customer (avg. use 2.5 hrs. daily each customer)		75@10c	7.50	20	150 0.0	500	3,750	......
					Lighting Total			5,625

17. Misc. Devices (Oil Burners—Pumps—Storage Batteries, Wireless, etc.) not included

Ultimate total increase per 1000 Residence Customers	$58,355
New Revenue—Per Customer, year	$58.35
Per Customer, month	4.86
Per Customer, day	.15

Above possibilities for Residence service alone by percentages are as follows:

Income from use of Merchandise Appliances	$ 6,180 =	11%
Income from use of Domestic Lighting	5,625 =	10%
Income from use of Promotion Devices	46,550 =	79%
	$58,355 =	100%

*Northern City figures only.

**If we attain 250 ranges per 1,000 customers, due to diversity, but ¾ Kw. would be required at Gee. Station per range then gross income for this added service at 4c. Kwh. would be $100 per Kw. at Gen. Sta. probably operated at 50% or better operating ratio. This on existing service and preferably one with but meter.

***After allowing for diversity.

III. *That the time has come when the electric industry should establish for itself a definite sales responsibility for electric appliances.*

1. Even with a liberal use of electricity its cost is lower than that of any items on the luxury list comprising expenditures for candy, ice cream, gasoline and tobacco, about which the average citizen thinks little. The following figures, compiled by the electrical engineering department of the Iowa State College, will show how cheap the use of electricity really is.

Average family's yearly expenditures:

Tobacco	$95.00
Gasoline	68.00
Ice Cream	50.00
Candy	48.00
Electricity	25.00

2. The cost of using individual electric appliances is as follows. Normal use, cost per hour, based on 10c. rate.

Vacuum cleaner	1¾c.
Iron	6c.
Toaster	5c.
Ironing machine	3c.
Clothes washer	3c.
Dish washer	2½c.
Sewing machine motor	¾c.
Electric phonograph	1/5c.
Waffle Iron	6c.

These figures were compiled by the Service Department of the N.E.L.A.

3. The electrical industry in Calior nia, after a very thorough analysis, has come to the conclusion that every household should spend as much for electrical equipment as it spends for its automobile. They feel that the time has come for the installation of complete electrical equipment and they are making a concerted drive for the realization of that end. Ontario, with its big development, should set up a similar program.

4. According to statistics compiled by "Electrical Merchandising" to every fifteen homes having automobiles in the United States, there are only 5 having electric vacuum cleaners, 10 having electric irons, 5 having electric fans, and 3½ having electric clothes washers. Shall we not establish for ourselves a program that will comprehend the selling of as many of the major appliances as there are automobiles in any given community.

IV. *That the electric industry dealers today are not sufficiently sold on the service and utility of electrical appliances.*

1. F. J. Allen in discussing this question before the New England convention recently said: "The fact that we ourselves are very much unsold on the appliances was clearly evidenced at a recent commercial section meeting when out of 200 members, only two were able to say that they were using in their own homes all, or nearly all, of the appliances which they were trying to sell to the public." He further stated that there is only one way to get real honest-to-goodness conviction of anything you are trying

to push and that is to use it yourself. He continued: "We electrical appliance men are not successful merchants primarily because we do not really know what and how the various devices perform their functions and the unlimited possibilities and economies which they can introduce into the home."

2. Electrical appliances while out of order consume no energy, and repair troubles discourage the purchase by consumers of other appliances. For these reasons the Detroit Edison Company has steadily built up a huge repair business. Repair jobs and service calls made by this Company in 1923 numbered 173,928. During the first six months of 1924 they numbered 90,719. This department is maintained as a matter of service and charges seldom cover the cost of materials used. By giving exceptional service in this respect the Company not only keeps electrical appliances in its city working, but also encourages sales of other appliances by keeping the householder more than satisfied with their investment.

3. The Valley Electrical Supply Company of Fresno has made its repair department a separate department. It has an office of its own with a trained attendant always on hand. He is able to show the customer what is the matter with her appliance before she leaves it. No charges are made for minor repairs, such as replacing screws or the repair of worn insulation on the cord. The time and materials required are neglible as balanced against the goodwill which comes from this free repair service. In cases where the cost of repairing would be more than the cost of the new appliance, it often is possible to make a sale on the spot. Reports kept for the seven months' period since this department was organized show that over 500 articles have been repaired. This means 500 friends for the Company.

4. Central Station management, as a whole, so far has not shown the enthusiasm that might be expected in the merchandising of appliances. Many appliance departments are placed in an inaccessible or obscure part of the building. The other day in an Illinois town I found the office occupying all the desirable space on the first floor and the Appliance Department shoved off in one corner. In another town I found it in the basement of the building occupied by the Central Station. This certainly is a wrong attitude to assume towards the department that has within it the greatest possibilities for good-will building as well as the only department that will consistently and regularly build up the consumption of current in the home.

V. *That to reach the possible market for electric appliances the industry should universally make use of modern merchandising ideas and methods.*

1. Its advertising should be built on facts, not hunches. A western Central Station operating in about thirty towns began a campaign on washing machines. These were advertised extensively in the news-

papers. Their basic appeal was that of economy. The campaign did not go over. A washing machine was offered as a prize for the woman who would send in the best reason why a woman should have a washing machine. Over 2,000 replies were received and these are the reasons according to the women themselves.

- 30% wanted the machine because it saved time,
- 25% because it saved strength,
- 14% because it saved health,
- 12% because it preserved youth and beauty,
- 8% because it was more economical,
- 7% because it contributed happiness to the home.

The advertising campaign was changed to conform to the information secured from the prospects and sales went over with a bang.

2. The industry must appreciate the fact that satisfactory profits are made from turnover, not markup. A common street peddler will invest $25 in fruit or notions. He will sell this out each day with an average profit of $6.00 per turnover. At the end of the year he will have made $1,800 cash profit for himself in a stock of investment of $25. Take another example based on an investment of $20,000. Suppose we give the $20,000 stock a 50 per cent. mark-up with a selling price of $30,000. Let us allow 20 per cent. of this sum for overhead expense, including the owner's salary. This will be $6,000. Let us allow $1,500 for interest. This leaves us $2,500 for profit. In the second column we have two turnovers. The merchandise sold would be valued at $60,000. The fixed interest and overhead would be $7,500. The cost of the stock plus the fixed expense would be $47,500. This amount subtracted from $60,000 cash value of the merchandise sold, would leave $12,500 or a profit five times as great for two turnovers as for one turnover.

3. Our merchandising drive should be set up for twelve months in the year. There was a time when the electrical industry thought that appliances, such as cleaners, could not be successfully sold except at house-cleaning time. We have learned, nevertheless, that there is no closed season for the selling of appliances. Recently I took one Hoover sales division and checked their sales against the average sales of the department stores for the country and I found that month by month they practically paralleled the department store sales.

A Southern Central Station recently put on a special campaign for electric ranges in the winter and sold more than it had ever sold during the same time in the middle of the summer. There are just as many sales arguments for electric cleaners. table appliances, washing machines, and electric ranges for winter as there are for summer use. For several years The Public Service Company

of New Jersey has put its Hoover campaign on in July and August and has always run up tremendous sales during this period.

VI. *That there remains some unfinished business before the electric appliance industry.*

Every industry that prospers has an ultimate ideal, an aim that cannot be realized in a year, and possibly not in a century. With us it is without question the servantless home made possible through the development and use of public utilities. The ice cream man has put an end to home ice cream making. The woman today who bakes her bread is almost unheard of. The clothing manufacturers and ready-to-wear manufacturers have put an end to the long laborious days over the sewing machine. Just so the appliance industry should plan to enter in 100% to the elimination of housekeeping drudgery in every Canadian home. When this has been done, our housewives will no longer grow old at thirty-five. Gentlemen, I propose a toast to the servantless home, and if I were asked to suggest a song it would be "Until the Sands of the Desert Grow Cold."

Discussion

The President: Gentlemen, I know you will all agree with me that Mr. Pierce has presented a most interesting and instructive paper. He has opened up several points that most of us have not even thought of.

Those who have operated central stations for a number of years know that, say, four or five years ago the average kilowatt hour consumption per month per resident was very low. Take today, the kilowatt hour consumption per month per resident has increased 400 or 500 per cent over what it was four or five years ago. That is due entirely to the sale of electrical appliances in the home.

I was rather amused at some of the statements of Mr. Pierce, in comparing electrical appliances with talking machines, and so on. He is quite right in bringing that up.

The saturation point, however, in Ontario, I think, is as Mr. Pierce said, the highest on the North American Continent. That is due to cheap power, you know that. However, there is one drawback to that. The cost of appliances, I think, in Canada is higher than in the United States. It is a question in the United States of cheap appliances and high cost of power, while in Canada it is a question of cheap power and high cost of appliances.

Mr. W. H. Childs, Hamilton: I think Mr. Pierce completely and absolutely hit the nail on the head when he said it was turn-over first. I know, as far as we are concerned, we have had a lot of experience in

that particular line, and I am very pleased to say that most of it is past. You know, as we all know, that an article that stands on the floor is an opportunity lost, and from getting the fifty per cent added at the end of the year what usually happens is that you knock off about twenty or twenty-five dollars from the cost of the article and lose that too to get rid of it.

There is no question at all that while we are at a very high point of saturation in Ontario, with the chart that Mr. Pierce has drawn exactly the same in Ontario, you will find, for instance, that you are going to put in more new services in your town in a year than you are selling appliances, so that you are getting further away from your objective all the time, if your objective is saturation. That is so, I believe, in every municipality.

I think Mr. Pierce has, to my mind, taken an unfair advantage of us, because while he pointed out so clearly to the members that if your prospect will only raise an objection he gives you a good point to sell him, you will notice that Mr. Pierce did not raise any objections, and he has left very few points to hit.

I think certainly we have a wonderfully fine opportunity to sell appliances in Canada. Times are not good at the present, but even under present conditions we have an opportunity that is not offered by any other country or province, and with such an opportunity before us, and Mr. Pierce's very able remarks, I think that the Commissioners who are here will, no doubt, go back and prod up their sales managers, and the sales managers who are here will go back and prod up the salesmen, and the salesmen who are here will go back and prod up themselves.

Mr. W. R. Caton, Brantford I want to say that in our City we have not a Hydro shop, but we have got a live bunch of contractors, and to illustrate how much alive they have been I prepared a chart of a purely lighting feeder supplying about 2,000 customers. Our load on that feeder between eleven and twelve o'clock is 1,200 kilowatts; in the evening, when it is straight lighting, including street lighting, it is only 700 kilowatts. I think that is proof positive that the people in Brantford are certainly taking on the appliances. If our load continues to climb between eleven and twelve o'clock, we will soon have to go out and check some of those fellows who are selling appliances, because the load is getting beyond us at that hour of the day.

The Saturation Point Still Far Off

By G. J. Mickler, Sales Dept. H.E.P.C. of Ont.

(Discussion following Mr. Pierce's paper.)

A survey was made recently of the electrical appliances in use in all the Municipalities of Ontario at the end of 1924. Questionnaires were sent out to every Hydro Manager to ascertain how many of the different types of electrical appliances were connected to their lines when the survey was made. These questionnaires were returned by practically all of the Municipalities with some of the desired information tabulated. A great many Municipalities were able to give information on a few appliances only. Other Municipalities gave information on a few different appliances, while quite a number found the information to be obtained from a survey of sufficient value to themselves, as well as to the Commission, to make an actual count among their customers of the appliances in use.

In tabulating the results of these questionnaires, in order to arrive at an estimate of the total number of appliances installed, to take care of instances where no figures were given, but where it is quite evident and within the knowledge of the writer, that appliances are in use, certain calculations had to be made to arrive at an estimate.

The questionnaires received were divided up into a number of districts corresponding to the different systems operated by the Commission. The information received on the appliances in use was reduced to an average per customer in each system, assuming that the habits of the people in each system were about the same on the average. Depending on the number of customers involved in the figures actually obtained from the questionnaires, the estimate finally set was arrived at by increasing the actual figures by the figure obtained when multiplying the average by the number of customers for whom no figures were reported.

While the results obtained from this survey are approximate only, and in a great many cases are produced from estimated figures, we are quite safe in saying that they give a very fair and approximate idea of the number of appliances in use at the present time.

The following tabulation shows the results of this survey, and shows also the percentage of saturation which has been reached in the use of the various appliances by the Hydro customers in Ontario.

TABULATION SHOWING THE NUMBER OF THE LARGER ELECTRICAL APPLIANCES REPORTED IN USE BY HYDRO CUSTOMERS IN ONTARIO AT DECEMBER 31, 1924, ALSO THE ESTIMATED NUMBER INSTALLED AND THE PERCENTAGE SATURATION OF EACH APPLIANCE

	Number of Muncipalities Reporting out of Total of 256	Number of Wired Homes Represented by Reports Submitted out of Total of 345,000	Number of Appliances Reported in Use, Dec. 31, 1924	Estimated Number of Appliances in Use, Dec. 31, 1924	Percentage Saturation of Percentage of Number of Customers Using Appliances	Estimated Total Installed Capacities Kilowatts
Ranges	180	316,650	44,392	47,505	13.8%	285,000
Hot Plates	147	124,039	7,668	18,883	5.5%	37,766
Washers	168	133,652	21,881	55,342	15.8%	11,068
Cleaners	153	118,251	22,504	64,205	18.6%	12,840
Water Heaters	133	156,367	7,775	16,665	4.8%	33,330
Grates	108	77,798	2,649	15,075	4.4%	30,150
Air Heaters	126	105,205	30,281	103,000	30.0%	87,400
Ironers	70	81,300	.405	1,590	.4%	4,770
Irons	158	119,686	105,277	307,800	89.2%	203,148
Refrigerators	35	80,000	158	657	.2%	125
Toasters	159	119,208	52,794	152,200	44.1%	83,710
Grills	130	107,090	16,673	46,800	13.8%	30,888

A very interesting part of this tabulation is that it indicates the connected load of the appliances in use in Ontario. From the figures shown there are approximately 808,775 k.w. connected in electrical appliances at the present time, and allowing for such appliances as sewing machines, electric fans, percolators, waffle irons, immersion heaters, curling tongs, heating pads, radio charging outfits, lighting and so forth not included in the above tabulation, we are safe in estimating the additional installed capacity at another 250,000 k.w.; thus it is evident that with a total installed capacity of 1,058,775 k.w. or 1,411,700 h.p., the domestic consumers of Ontario are contributing in a very large measure to the existing demand for electrical energy from all available sources in the Province.

When you stop to figure just what would happen were the saturation in all lines complete, the figures would be staggering—yet such is within the realms of possibility. Assuming that every customer in Ontario will ultimately have, as he should, all of the appliances listed above, there would be over 5,500,000

h.p. of possible load among the customers now connected with the systems operated by the Commission, and added to this possible load would be that of customers added to the system year after year.

It is also within reason to expect that appliances not yet thought of will be placed within reach of each customer as time goes on. The increasing possibility of utilizing lighting circuits in place of radio batteries will create tremendous demand for electricity to serve the needs of radio fans throughout the country, but this new use has not been figured on in the estimate of possible load already in sight.

That we have need for a rapid development of the power resources in the Province is quite apparent from the figures submitted, and from the ever-increasing load created by the increasing use of appliances in the home.

Hydro Shops' Contribution Towards the Saturation of the Electrical Appliance Field in Ontario

By G. J. Mickler, Sales Dept. H.E.P.C. of Ont.

(Discussion followsng Mr. Pierce's Paper).

FROM information gathered from every Hydro Shop in the Province of Ontario the following tabulation was made, showing the total of the various appliances sold by each during the year 1924.

Some Municipalities are actively engaged in merchandising; others sell only when consumers are anxious to buy through the Hydro, or where there is no recognized electrical dealer in the Municipality, whose customers want to be up-to-date. Municipalities which are conducting an up-to-date Hydro Shop are contributing very rapidly to the saturation of the electrical appliance field in their own communities. This fact is illustrated by the large number of the large current consuming devices which are sold in these Municipalities by the Hydro Shops alone.

In the tabulation submitted, no figures appear indicating what is sold by contractor-dealers or others selling electrical appliances, and it is safe to assume that in nearly all Municipalities a large percent of the appliances sold to Hydro customers are sold by contractor-dealers and others. Had it been possible to secure figures they would be tabulated along with what we have, but it is impossible to get contractor-

APPLIANCES SOLD BY VARIOUS HYDRO MUNICIPALITIES THROUGH THEIR RESPECTIVE MERCHANDISING DEPARTMENTS OR HYDRO SHOPS DURING 1924.

	Ranges	Hot Plates	Washers	Vacuum Cleaners	Water Heaters	Grates	Air Heaters	Ironers	Irons	Refrigerators	Toasters	Grills
Acton	8	9	6	0	3	4	11	0	11	0	5	6
Barrie	3	3	0	0	5	3	7	0	12	0	5	0
Belleville	31	5	18	44	23	4	43	0	73	0	11	37
Bowmanville	17	20	8	5	11	2	20	0	35	0	25	10
Brighton	1	1	5	1	0	0	4	0	24	0	20	0
Carleton Place	1	0	7	4	0	0	8	0	4	0	20	1
Cannington	1	0	1	0	1	2	0	0	3	0	2	0
Clinton	9	5	10	1	6	3	12	1	24	0	9	10
Cobourg	4	1	12	3	2	0	10	0	32	0	31	3
Chatham	40	28	0	10	16	1	50	0	62	0	75	71
Collingwood	11	3	4	0	3	0	13	0	13	0	9	14
Dundas	1	3	0	0	0	0	6	0	8	0	9	0
Elmira	1	1	1	0	0	0	4	0	18	0	4	3
Exeter	16	5	4	1	6	0	12	0	10	0	5	1
Etobicoke	12	5	5	0	2	1	7	0	12	0	6	3
Forest	8	4	0	0	0	0	0	0	0	0	0	0
Goderich	8	4	1	0	1	0	0	0	27	0	11	5
Georgetown	1	1	0	1	0	0	2	0	12	0	1	0
Galt	89	66	53	20	17	5	61	0	103	0	90	12
Guelph	33	0	1	1	6	7	54	2	12	0	7	6
Hamilton	501	21	272	184	99	42	80	11	190	0	137	5
Ingersoll	35	4	4	0	12	14	15	0	32	0	13	3
Kemptville	0	0	1	1	1	0	3	0	12	0	3	4
Kitchener	134	23	29	7	7	18	67	1	98	3	83	4
Kincardine	2	1	2	1	0	0	2	1	6	0	10	1
London	605	69	393	134	51	0	323	12	322	11	174	20
Lindsay	8	3	20	1	5	0	2	0	35	0	11	5
Midland	12	17	37	4	9	0	22	0	30	0	49	11
Milton	1	1	1	0	0	1	8	3	5	0	3	1
Millbrook	1	0	0	0	2	0	2	0	5	0	5	0
Mitchell	12	24	1	4	0	0	12	0	18	0	6	0
Niagara Falls	115	13	15	1	36	0	26	0	28	0	9	3
North Bay	8	7	10	4	5	0	12	0	61	0	58	3
New Hamburg	5	1	0	0	1	1	6	0	4	0	0	0
New Toronto	3	1	0	1	0	0	8	0	2	0	0	0
Napanee	6	6	2	6	4	0	4	0	12	0	6	0
North York	9	2	2	0	1	1	4	0	10	0	6	2
Oshawa	10	4	14	3	0	1	10	0	56	0	23	3
Owen Sound	8	3	4	5	7	3	20	2	46	0	26	15
Ottawa	161	52	0	0	61	3	78	0	216	0	104	73
Perth	4	5	0	3	2	0	17	0	30	0	12	31
Palmerston	11	2	0	0	2	1	0	1	0	0	0	0
Picton												
Paris	23	7	14	0	0	0	0	0	1	0	1	0
Peterboro	17	2	16	3	17	0	7	1	15	0	12	4
Petrolia	14	0	7	4	5	0	15	1	20	0	7	4
Ridgetown	3	0	0	0	0	0	15	0	10	0	5	8
Sarnia	90	27	130	30	6	11	60	4	120	0	70	6
Seaforth	7	1	4	1	5	0	6	0	28	0	3	5
Stamford	121	18	59	24	30	16	0	1	36	0	24	4
Stratford	140	45	84	23	19	31	45	2	89	0	40	10
Strathroy	24	11	14	11	11	6	16	0	23	0	6	12
St. Thomas	70	24	125	18	20	10	60	2	50	0	75	35
St. Marys	18	7	9	4	2	0	20	0	20	0	19	2
Toronto	994	160	531	684	219	0	577	24	4304	0	846	577
Trenton	5	9	8	4	2	1	7	0	27	0	6	23
Tweed	0	2	1	0	0	0	2	0	8	0	4	1
Tillsonburg	12	5	10	0	3	4	2	0	20	0	25	2
Waterloo	55	6	0	3	12	2	15	0	36	0	15	0
Wallaceburg	13	0	13	0	4	1	0	0	0	0	0	0
Wingham	5	0	7	2	4	0	5	0	20	0	31	1
Winchester	4	3	1	1	1	0	2	0	4	0	2	7
Woodstock	45	16	7	10	13	13	5	0	22	0	9	2
Walkerville	676	25	222	125	110	12	110	8	250	7	185	15
Windsor	1070	121	254	109	177	30	222	10	545	2	229	19
Welland	13	0	8	10	7	0	10		25	0	15	3
Totals	5365	912	2467	1516	1074	253	2260	87	7386	23	2733	1106

dealers to estimate or publish figures showing what their sales are for any period of time.

Summing up the estimated installed capacities of these various appliances it is estimated that the total possible load added to the Hydro Systems in Ontario by the operations of Hydro Shops during the year 1924, was over 60,000 h.p. Of course, there is a considerable diversity in the use of electrical appliances and in the consequent load created on Municipal Systems. What this diversity is it is impossible to figure, but the Hydro must be ready to serve a large percent of this increased demand whenever it occurs. It is quite evident that the operation of Hydro Shops in the Province is contributing in a large measure to the existing-ever-increasing demand for electric power.

Comparison of Hydro Shop Operating Reports for 1924

By G. J. Mickler, Sales Dept. H.E.P.C. of Ont.

(Discussion following Mr. Pierce's Paper.)

THE statement showing the figures making up the operating reports for nine Hydro Shops for the year 1924, which you have in your possession, gives us in a very striking way comparative information about the operations of Hydro Stores, and is well worth very careful study.

The names of the Municipalities whose reports are shown have been left off this report for various reasons, although there is no doubt that the reports can be identified by those present from information they may have. If you will look at the statement, you will at once be impressed with the magnitude of Hydro Shop business in some Municipalities; of the importance of this branch of the Hydro enterprise, and of the necessity for a most rigid policy governing its operations, to prevent loss and to avoid criticism.

There are other Municipalities, whose reports are not included in this statement, with equal or greater volume of business, and when you consider that the total sales of Hydro Shops during the year 1924 was approximately $1,750,000.00 you will grasp the necessity for close supervision of all Municipal Hydro Shops, and frequent comparison of the results of one with those of another, in order to eliminate waste and increase the efficiency of operation.

COMPARATIVE OPERATING STATEMENTS OF 9 HYDRO SHOPS IN 1924

unicipality Number	No. 1	% of Sales	No. 2	% of Sales	No. 3	% of Sales	No. 4	% of Sales	No. 5	% of Sales	No. 6	% of Sales	No. 7	% of Sales	No. 8	% of Sales	No. 9	% of Sales	Total	% of Sales
al Sales	$37,235.64	100.0	$139,000.00	100.0	$35,779.56	100.0	$170,000.00	100.0	$17,263.95	100.0	$43,148.62	100.0	$230,019.80	100.0	$177,209.94	100.0	$38,666.52	100.0	$888,324.01	100.0
oss Profits	5,827.00	15.7	30,855.96	22.2	7,997.38	22.4	36,862.83	21.7	4,624.60	26.8	7,472.91	17.3	52,751.07	22.9	36,383.49	20.5	8,377.74	21.7	191,152.98	21.5
st of Handling	749.30	2.0			417.61	1.2			341.85	2.0	299.97	.6	2,840.09	1.2			660.93	1.7	5,309.75	.6
ance of Profits	$5,077.70	13.7	30,855.96	22.2	7,579.77	21.2	36,862.83	21.7	4,282.75	24.8	7,172.94	16.7	49,910.98	21.7	36,383.49	20.5	7,716.81	20.0	185,844.23	20.9
EXPENSES																				
es Tax	28.40								18.50		5.36								52.26	
livery											350.00	0.8	2,601.47	1.2			33.03		2,984.50	.3
aries, Commissions nd Labour	1,797.13	5.1	9,478.07	6.8	2,451.31	7.0	17,141.48	10.1	1,800.00	10.4	2,111.05	4.9	25,525.74	11.1	22,479.51	12.7	3,263.92	8.7	86,048.21	9.7
vertising	285.90	0.7	2,706.53	2.0	616.60	1.7	3,370.58	2.0	214.83	1.3	1222.36	.3	3,105.47	1.3	5,754.62	3.3	626.68	1.6	16,803.57	1.9
nt	600.00	1.6	11,000.00	8.0	1,353.52	3.5	3,000.00	1.8	1,200.00	7.0	300.00	.7	3,000.00	1.3	2,400.00	1.3	1,200.00	3.1	24,053.52	2.7
urance and Taxes			83.00		48.33	0.2							396.75	.2					528.08	
erest on Investment	1,200.00	3.2	3,238.55	2.3	486.07	1.4	5,077.78	3.0	381.58	2.3	476.20	1.1	5,975.46	2.6	3,475.23	1.9	724.68	1.8	21,035.55	2.4
neral Expenses	634.08	1.7	2,067.63	1.5	1,043.54	3.0	6,190.05	3.6	300.63	1.8	791.75	1.9	3,387.49	1.4	3,947.59	2.3	158.96	.4	18,521.72	2.1
pection Fees									24.60		29.15								53.75	
ee Service	2.81				15.32														18.13	
d Debts							331.36	.2					1,059.52	.5					1,390.88	.2
preciation on Stock							880.95	.5											880.95	.1
preciation on Equip.													841.30	.3					841.30	.1
al Expenses	$4,548.32	12.3	28,573.78	20.6	6,014.69	16.8	35,992.20	21.2	3,940.14	22.8	4,185.87	9.7	45,893.20	19.9	38,056.95	21.5	6,007.27	15.6	173,212.42	19.5
t Profit	$529.38	1.4	2,282.18	1.6	1,565.08	4.4	870.63	0.5	342.61	2.0	2,987.07	7.0	4,017.78	1.8	— 1,672.46	1.0	1,709.54	4.4	12,631.81	1.4
INVESTMENT		T.O.		T.O.		T.O.		T.O.		T.O.		T.O.		T.O.		T.O.		T.O.		
uipment					694.51				95.66		720.19									
entories	$10,567.91	3.0	10,407.72	10.7	8,112.25	3.4	36,620.88	3.8	2,511.10	5.1	2,885.24	12.5	32,451.88	5.7	19,321.62	6.4	7,318.48	4.		
counts Receivable	8,633.78		52,222.49		8,801.80		53,918.59		4,089.31		8,302.40		86,573.32		53,562.38		21,151.81			
tals	$19,201.69		62,630.21		17,608.56		90,539.47		6,696.07		11,907.83		119,025.20		72,884.00		28,470.29			

If you will examine the report you will find that the gross margin of profit varies from 15.7 to 26.8 per cent. In these days of fixed resale prices, and almost uniform rates of discount from manufacturers to dealers, it is perhaps difficult to understand why there should be such a variation in the rate of gross profit as indicated by these figures. There may be one or more Municipalities who charge into the cost of the material sold the cost of handling that material, before considering their gross profit; that appears to be the case in Nos. 2, 4 and 8, and if in these were shown the cost of handling the merchandise, undoubtedly the rate of profit would be slightly higher than that shown.

One conclusion which must be arrived at, and which undoubtedly is the cause of this variation in profits, is that a great deal of merchandise was disposed of during the year 1924, but purchased in previous years and sacrificed in order to get rid of it. This is the result of poor buying; the buying of discounts rather than the securing of profits, with the ultimate loss of the latter. It is believed that most Hydro Shops have benefitted by the experience of this practice, although there appear to be some who still believe that 2 or 3 or 4 per cent extra discount on quantity purchases, is good business, when the market for the goods to be purchased is a questionable one.

The average gross profit for all the Shops, whose results are compared, is 21.5 per cent, or 19.9 per cent when they are all reduced to a common basis, excluding handling charges.

If you will examine the various items of expense across this statement, you will find a wide variation in the amounts and percentages required by the different Municipalities to carry on their business. For instance, salaries and commissions vary from 4.9 per cent of the sales up to as high as 12.7 per cent of the sales. Some of this variation may be caused by the lack of uniformity in the allocation of the different items of expense. One Municipality may charge certain salaries to other accounts, while still others will charge all salaries, whatever they may be, to Salaries Account. It is hoped that with a closer supervision during 1925 of the Hydro Shop Accounting System by the Auditors that this lack of uniformity will be eliminated to a very large extent, and more comparative results obtainable for 1925. Aside from this difference in allocation of charges however, it is apparent that it is costing some Municipalities much more than others to sell merchandise; perhaps a great deal more than it should.

Advertising varies from 3/10 of 1 per cent up to as high as 3.3 per cent. This wide variation in cost of advertising is largely due to the difference in policy which exists in different Municipalities as to the apportioning of advertising expense as between the Hydro Shop and the Utility in general. The recommendations which were made on this subject at the January Convention are well worth looking into, and if they are followed perhaps a

more uniform percentage than that shown in this statement will prevail in future. It is important, if we are to compare the operation of one Store with that of another, that uniformity be displayed in the allocation of expenses of the different Municipalities.

Rent varies in percentage from 7/10 of 1 per cent to as high as 8 per cent, and here again there is room for the application of more uniform basis for calculating rent. Of course there are certain fixed items of expense which regulate the rent to be charged in different Municipalities. These items of expense depend largely upon the size of the Hydro Shop, original cost of the building occupied, and the amount of business done, but the Hydro Shop should not be burdened unduly with the charge for rent, which could not be justified in any other line of business.

Interest on investment varies from 1.1 per cent to 3.2 per cent. As the interest on investment depends entirely upon the amount of Inventory and Accounts Receivable balances carried, it is important that both of these items be reduced to the absolute minimum to keep the charge for interest within reason. There is no doubt but that some Municipalities are carrying too large an amount in outstanding accounts and in Inventory, and that a serious attempt must be made soon to reduce both within the limits of reason.

General Expenses are found to vary from 4/10 of 1 per cent to [illegible].6 per cent. This variation is also caused by difference in allocation of accounts.

All of these differences which are due to the variation in the method of allocating expense items, or at least the greater part of them, could be eliminated if the method of allocating accounts, of the various items of expense involved in the operation of a Hydro Shop, as laid down in the pamphlet issued a year ago, outlining the Hydro Shop Accounting System, were followed. This pamphlet sets out very clearly how to divide up expenses and where to charge them.

The item 'Free Service' evidently has no place in the majority of Hydro Shop accounts, although if we were to question the Managers of these Shops we would find that a great many cases where service is given free of charge, and it is in order to determine the extent of this free service that such an account was put among the accounts of the Hydro Shop Accounting System.

On the item for 'Bad Debts' we have only two Municipalities who have gone so far as to write off uncollectable accounts, although from the list of outstanding Accounts Receivable examined from the other Municipalities it is quite apparent that this account Bad Debts is in need of some attention.

The question of collecting accounts is one that is receiving too little attention in practically all the Hydro Shops today. The most important feature in selling electrical merchandise today seems to be to make a sale. The fact that profits are only realized when the total amount of the sale has been collected is too often lost sight of, and if the truth were known, a lot of so-called surpluses

would be wiped out altogether if the bad accounts were treated as they should be. There is no excuse, of course, for allowing so many bad accounts to accumulate on the books. The first essential should be to make a hard and fast agreement with the customer who asks for time; second—the customer should be required to pay the instalments as they come due, on the penalty of having the appliance repossessed, or light and service cut off, or both; third—that the amount due on instalments be made part of the monthly lighting bill, so that the customer cannot easily escape paying the instalment when he goes to pay his electric light bill. Variations from these rules should only be allowed in extreme cases.

Items of depreciation on Inventory and Equipment have apparently been overlooked in most Municipalities, although it is a well-known fact that several Municipalities reduced their Inventory at the end of 1924 by a substantial amount, and certainly the Equipment used in operating a Hydro Shop is subject to depreciation the same as anything else in the System. Anything written off either the Inventory or Equipment should show as an item of expense, rather than as a deduction from gross profits, before the expenses are calculated.

In the total expenses of all these Municipalities the percentages vary from 9.7 to 22.8 per cent, and the net profit from minus 1 to 7 per cent, with the majority of them ranging around 2 per cent.

This brings to our attention again a matter which was mentioned at last year's Convention, namely—that electrical dealers, including Hydro Shops, find it very difficult to carry on legitimate business on the existing scale of discounts allowed by manufacturers and jobbers, and while some criticism may be levelled at expenses which are incurred in operating Hydro Stores, even where the greatest economies are effected, it is difficult to show a surplus worthy of the name.

It is a well-known fact that other household commodities, such as furniture, hardware, jewellery, musical instruments and so forth, carry equal or greater scale of discounts between the manufacturer and the dealer. Dealers in these commodities lose all interest in anything which they sell as soon as it goes off the floor, excepting so far as it effects the collection of their accounts. There is very little demonstration required after the goods are sold, and there is practically no service after they are put into use, so that the dealer is left to enjoy all of the discount which the manufacturer allowed him, and he can regulate his expenses accordingly. With electrical appliances, however, it is different. An electric appliance as soon as it is sold becomes more or less of a liability on the dealer for two reasons—

1st. In order to keep it properly sold, it must be properly demonstrated to the housewife. Sometimes more than one demonstration is necessary for proper education.

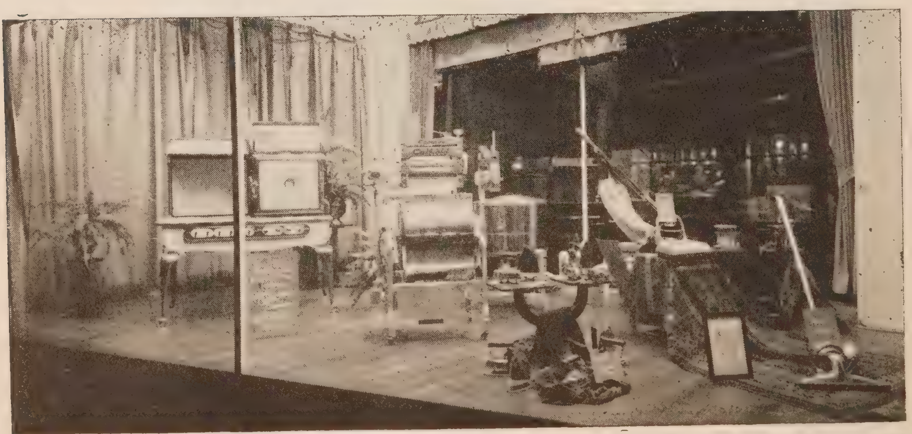
2nd. During the first year of operation it must be serviced

free; it is guaranteed for a year.

Demonstrations and service cost money, and the ultimate benefit from both redounds to the manufacturer, not to the dealer, because the satisfaction of the customer makes for further sales of a particular appliance, and the dealer, including the Hydro Shop, is bearing an expense out of proportion to the amount of good he gets out of it. If we are to maintain the confidence of the public in electrical appliances, they must be properly sold and properly serviced. If they are to be properly sold and properly serviced it must be made worth the dealer's while to perform these functions, and that can only be done by showing a profit on his operations.

A further examination of this statement will show that the turnover of stock in various Municipalties varys from [illegible] to 12.5 per cent, and you will see that where the turnover is highest, as a general rule, the profits are greater. This is due to the fact that interest charges are less where the inventory is low, and further, that there is less need for writing down of Inventory because of stock becoming out-of-date, and unsaleable at standard prices.

From the figures showing the amount outstanding as Accounts Receivable, it is at once apparent that drastic action must be taken in some Municipalities to collect the outstanding accounts. It is, of course, understood that when times are bad, collections are slow, but it is far better not to make a sale, which includes paper profits, than to open account with a customer who will never be able to pay. Of course, it is not possible always to pick the customers, but the strict application of collection rules, according to the terms of the contract entered into at the time the sale is made, is necessary for the complete success of the operation of Hydro Shops throughout Ontario.



The Aims and Accomplishments of the Electric Service League

By G. W. Austin, Manager, Electric Service League Toronto.

(Paper read before Association of Municipal Electrical Utilities at Niagara Falls, June 25, 1925.)

THE Electric League as a market builder for the industry is becoming more important each year. There are now about 120 Leagues on the Continent, and new ones are coming to life at a rapid rate. They are proving their right to existence. An analysis of the marketing problems of the electrical industry demonstrates that Leagues fill a big gap—the need for concerted effort along educational lines. A League can perform functions no other unit can perform, and produce results no group or unit, by itself, can produce.

In having Leagues for continuous work at widening markets, the electrical industry is years ahead of most industries. Some of these have co-operative advertising, to sell an idea, as the "Save the Surface and you save all" advertising campaign, and the California fruit-growers have co-operative distribution. No other large industry, however, seems to have adopted local market building organization on the League co-operative basis. The needs of the electrical industry, of course, are peculiar. So much of electrical sales depends on *education* of the public that continuous propaganda of enlightenment is necessary. Advanced as we are in power matters in Ontario, we have a wonderful sales field yet untouched—and much of it, when sold, will not add to peak loads but will help to fill up the valleys on the load curve.

The electric League, then, is the co-operative pivot around which can be organized numerous activities that will help sales. Campaigns of many types, of an educational nature, can be conducted by a League. A League is essentially an Educational bureau. It derives its support from the various groups—the central station, the manufacturer, the jobber, and the contractor-dealer. By bringing *progressives* of the several groups together for team-work, it has infinite possibilities for good constructive business-building.

It may have a program in which work of very general advantage is performed, and then, again, it may go into specialty campaigns on behalf of groups such as ranges, washers, vacs, fans, etc. But League work must always be neutral—selling the general idea—and leave the individual interests to do their selling under such conditions of private or personal competition as they may create.

Co-operation will achieve many big selling successes when competition fails. Co-operation can CREATE

constructive opportunities. Competition grasps what springs up under ordinary procedure. It is not in the least difficult to appreciate the need of keen competitors getting together to see what *new* business can be developed by co-operation in the common interest. In Ontario, it is true, we still have men in the electrical business who are so bent on rivalty that they cannot see the larger field of co-operative construction. A League, to such men, is somewhat of an anomaly, a fanciful creation. But fortunately that type is passing. These men will find that Leagues do not pull individual chestnuts out of the fire; that they remain above trade controversies or price disputes; that they do not act as SELLING AGENTS for any individual supporting interest—and then their attitude will change. A League is strictly an educational agency for widening markets for electrical sales, and for building the co-operative idea, to benefit all.

A League may conduct electric homes, electric shows, commercial lighting and wiring campaigns, special seasonal sales campaigns, act as an information bureau to the public, contribute constantly educational material to newspapers and other publications, and do many other general services. In Cleveland the local League raises $60,000 and has a staff of nine employes, most of whom do educative field work in special lines. There is no limit to the constructive activity of a League, save that of the provision of the necessary sinews of war.

A League exists by subscription, and as it earns no money, but spends, broadminded, generous support is essential. The usual practice is for the Central Station to put up dollar for dollar of the subscriptions, as all market building reacts to the advantage of the Central Station's business.

While there are 120 Leagues on the Continent, Canada has but two—one in Vancouver, and the Electric Service League of Toronto. The operation of the Toronto League has some special interest, because it is the foremost Canadian League, and its work is performed among typically Canadian conditions, which are somewhat different from those in the United States. The Toronto League was incorporated in 1922 to hold electric homes. Two were put on, and 30,000 people visited them. One often hears, even now, those electric homes spoken of. In July, 1923, the League was put on a steady operating basis by the engagement of a paid manager. With the addition of a field man, the League is now a continuous operating force in the Toronto field. It has constant contact with a thousand builders, and with all sorts of people wishing wiring or other information. The operation of the League is supervised by twelve directors, representing the Toronto Hydro Electric System, Ontario Hydro Electric Commission, the manufacturers, jobbers and contractor-dealers.

In its first complete year, 1924, the League established, on a firm foundation, its well-known Red Seal system; contributed to newspapers and periodicals nearly 45 news-

paper columns of specially written material; gave a number of addresses to business men's associations; published a number of educational folders, booklets, etc., for distribution to the builders and the public; conducted a Red Seal wiring display at the Exhibition; conducted a June Bride and Christmas Campaign; built up a contractor-membership of 80; organized a personal membership of manufacturers', jobbers' and central station sales staffs and other individuals; and performed, week by week, a great deal of special work in improving wiring standards.

The Red Seal system and field work were the main activities, and produced some remarkable results. This Red Seal system, which originated with the Toronto League, has spread to many American cities. Rochester, Syracuse, Buffalo, Pittsburg, Philadelphia, and many other cities have it or are adopting it. Probably it will become, within a few years, the Continent-wide assurance of adequate wiring in new houses. The Red Seal as a symbol, is already widely known. The Vancouver League now has an application before the Toronto League for a license to use this system.

The basic idea of the Red Seal plan is to grant a "Seal" certificate to a house for sale if the wiring job is up to a certain standard of quality set by the League. There is a small transfer seal which goes on the switch-box for permanent purposes. The utility of this plan lies in the fact that it sets up what the electrical industry regards as a fairly adequate specification, and proceeds by means of the advertising power of the seal, to get it adopted by builders. The builder who puts in a good job—up to the Red Seal standard—gets a seal to capitalize the fact in his sales talk. The public appreciates this protection. The electrical contractor gets a larger job, and the manufacturer and jobber sell more. The splendid thing about the plan is that it reaches past the electrical contractor who plays the "skimping" game, it reaches past the builder in the same class—to the buyer. Dozens of Toronto houses have been sold because they had Red Seals. Moreover, the establishment of the Red Seal standard means that most other houses under construction have more wiring. To meet the competition, builders put in a heavier service, or more outlets. The Red Seal is a symbol that gives the industry a definite method of selling the adequate wiring idea.

There are now streets in Toronto which are almost "plastered" with Red Seals on the houses. The 500 mark has been passed. The League put out in May alone, half as many seals as in all of 1924.

The specification is fairly stiff. It requires three No. 2 service on a house 7-rooms and up, three No. 4 service on 6 rooms and under; 100 amp. switch; range wiring to the kitchen; fuse-blocks for water-heater, ironer or grate; ample lighting and full switch control; and an average of 8 convenience outlets per house. In the course of field work the League has counted about 60,000 outlets in houses under construction, and has found an average of 54 outlets per Red Seal house, and 32 in non Red Seal houses.

Red Seal houses have an average of 11 base outlets and non Red Seals 4.

In 1924, the League added 10,000 outlets in new houses, besides hundreds of heavy services, and built up a far more adequate standard of wiring in house building as a whole. There are now 150 builders on the Red Seal list. The monetary value of this work is not easy to estimate. A census of 50 Red Seal houses this Spring has provided some data, however. These 50 houses had 47 ranges, 34 water-heaters, 37 cleaners, 32 washers, 50 irons, 47 toasters, 18 heaters, 28 grates, 96 table lamps, 72 floor lamps, 12 grills and 33 curlers. Allowing $100 for fixtures and all other appliances or equipment, and $150 per wiring job, there was an electrification, per house, of $550. If this average holds good for the 500 Red Seal houses, then there is $275,000 invested in electrification in these alone. In 1924, the League produced a 10 per cent wiring improvement, over the whole 2,500 houses built, and if appliance sales have followed in the same proportion as in the Red Seal houses, then the League widened the Toronto market by approximately $500,000, at a selling cost of 2 per cent.

Later on, the League hopes to establish more definite data regarding the actual business created by its labors. In the very nature of its work, it cannot measure the results of the more general of its activities, such as newspaper propaganda. But there is, to its credit, a definite, tangible increase of business in wiring and appliance sales, and as the League itself is still in the creative stage, with many new features to come, further organization and building should, in time, make it a powerful factor in the upbuilding of electrical business in the Toronto field.

Discussion

Mr. B. L. Baulch, Northern Electric Co., London I take it that the object of discussing this paper here is due to the possibility of extending the benefits of this to municipalities outside Toronto.

It is pretty well known that the Red Seal scheme has been confined to Toronto, and I would like to know what specific thing can be done to establish the Red Seal system in a community outside Toronto. Mr. Pierce, in his remarks this morning on merchandising of appliances, assumed that the facilities for installing appliances were available, but it is a very common thing for us here to find a contractor or possibly the Hydro confronted with the proposition to the contrary. The other day a contractor came into my office and said, "I have just lost a job." I asked him why, and he said the reason was because his competitor advocated three No. 8's whereas he was advocating three No. 6's. It seems a very sad state of affairs when people in the electrical business would go out of their way to cut down the size of their conductors

rather than increase them. We all know, at least those of us who are merchandising know, what we are up against when we come to sell an appliance, possibly as low as 10 or 15 amperes, the inadequacy of the wiring into the home.

I have had some knowledge of Mr. Austin's work in Toronto in connection with the Red Seal scheme, and there is no question in my mind but that it is something which should be of very great concern to those who are interested in merchandising and in seeing that the housewife, or house owner, has adequate facilities. They really do not know, in many instances, what these adequate facilities are, and this is one, definite, concrete way of informing them on that, and it seems to me that if we can find out, through the Red Seal scheme, some definite means of extending that to our municipalities we would be doing a wonderful thing for the electrical industry as a whole.

Mr. Austin I might say that I have had a lot of dealings with the manufacturers at various times, and I know that the manufacturing interests which, of course, are a very large supporters of a scheme like this, are not disposed at present in any way, owing to business conditions, to have a lot of individual contributions building up through the organization, but there is a way in which the Red Seal scheme could be spread around the Province and carried out in a good many communities without having to adopt that system. The local Hydro, in each case, and any local contractors who might be disposed to form a local association, could get together and they would appoint some responsible man as an inspector of the wiring job, and provide a certain amount of money, say several hundred dollars, enough to buy red seals and buy some of the paraphernalia. I think, if a Bureau were established in Toronto which would collect from the manufacturers of the Province enough money to carry out this work, this Bureau to have the responsibility of selling it to the manufacturers, and if it gets sufficient support it might be able to turn over a certain amount of money to the local association, then you would get a working scheme that would not involve any large expenditure of money, and you would be able to carry out your scheme, which operates in a small place very much better than a large place. But it is quite possible for local Hydros, if they want to adopt this system, if they will raise the money to get the seals and the other material at cost from the central Bureau at Toronto, and then will get the contractors, or some of them, to co-operate in the scheme on a neutral basis and provide for local inspection, why, the scheme can be very easily operated without an individual appeal to the manufacturers.

The Electric Service League of Toronto has protected this seal. We have a trade mark, copyright, registered as an industrial design, and I think we are entirely disposed to keep all rights for Canada. At the same time, the League is perfectly willing to issue licenses to other cities and make the very ordinary conditions except, of course,

as regards the operation of the scheme, and I think perhaps if we had other Ontario Leagues on that basis we could easily accommodate in the matter of licenses also.

But there is no question whatever in my mind that the scheme can be worked in a practical way, and if this is taken up in the proper spirit it might be possible for the Provincial body to take some interest in it. In the meantime, there is no reason why a local Hydro, if it is prepared to put up the responsibility of adequate inspection, which is the thing that would be insisted upon, together with some local contractor, could not begin a little scheme for the local municipality.

Mr. Baulch One other question, I would like to ask if it is Mr. Austin's opinion that one inspector could cover several municipalities?

Mr. Austin In the small towns I suppose building is not going on at such a terribly extravagant rate. In London, for instance, I suppose if they were doing 100 houses in the course of a year they would probably meet the demand. Our field man covers all round Toronto. He has covered 550 red seal houses, and he has covered 750, approximately, non-red seal houses, and he has counted 60,000 facilities in those houses. I do not see any reason whatever why a trip of once a week from London to St. Thomas, or in any district like that, where the building is not very heavy, would not be sufficient. I have no difficulty in the way of inspection.

Mr. O. H. Scott, Belleville I would like to ask Mr. Austin if he thinks it is possible for the use of the red seal through the local Hydros without the consent of the contractor needed? I have in mind a builder in our own city whom, I think, possibly would put in wiring in accordance with the specifications of the Electric Service League, and I think if I could go to him and say "You can put a red seal on your houses approved by the Electric Service League of Toronto," why, he would ask the contractor to put in the wiring in accordance with those specifications, and as far as inspection goes, I am sure our office would be very pleased to undertake the inspection right through if we can operate under the Toronto Service League.

Mr. Austin As a general rule, it is wiser and better to have the Red Seal system operated not by any one particular organization but by a neutral body. Now, there may be many cases in Ontario where the contractors and the local Hydro do not pull together, and in a case like that it would be very difficult to carry on the scheme. In Toronto, we now have a membership of 54 contractors. We cut it down from 80, because we were not satisfied that some of those who were on the list last year were of a type that would give us the credit we ought to have with the public. The contractor has a place in the scheme. It cannot be operated successfully without him, yet it is preferable always to have a contractor whom you know and have had actual association with, if possible. We

put the Red Seal scheme over in Toronto 95 per cent with the contractors, but I would like, if we could, to get along without any contractor members, and if we can get our situation in Toronto rearranged satisfactorily I do not know but what we might try it out. There are 250 contractor dealers in Toronto. We have 50 on our list, but I think that we might get a little bit further if we did not have any on our list. It is a problem that will have to be considered at length, and given more thought than has been given to it at present.

Mr. Eaulch Further to Mr. Scott's remarks, I would just like to ask Mr. Austin, would it not be possible where co-operation fully exists between the contractors and the Hydro, where the contractors are agreeable to have the Hydro do the inspection, would it not be possible in that municipality to deal with that on its merits?

Mr. Austin I cannot see, offhand, where there is any particular objection to the Hydro handling the inspection, for this reason, that the inspector has got to be an absolutely reliable man who is responsible to some other responsible organization. We would not be a bit content to give a license to any organization, or anybody outside Toronto, in Ontario, unless we were absolutely satisfied that the inspection would be bona fide in every case, and the local Hydro is certainly the body to whom you might look for adequate inspection, and I think I am pretty safe in saying that we would not consider a license to a body of contractors exclusively who would appoint inspectors on the jobs. I say that very deliberately, because I have seen too much of the efforts of contractors to avoid our specifications, and to be content to have red seals put out without our own personal supervision, unless we had a very, very responsible inspection.

Re. Municipal Populations

To enable The Bulletin to give as nearly as possible the correct populations of the Hydro Municipalities as shown in the lists on the inside of the cover, it would be of considerable assistance if the Municipal Officials advise of any corrections that should be made.

—Editor.


1926 January 1926
1926 March 1926
1926


1926 April 1926
1926 June 1926
1926 May 1926


1926 July 1926
1926 September 1926
1926 August 1926


1926
1926 December 1926
1926 November 1926

1926
Hydro Calendar

On the opposite page there is a reproduction of the four front pages of the new

1926 HYDRO CALENDAR

Every MUNICIPALITY should present it's customers with one of these CALENDARS in 1926. It is not necessary to be operating a HYDRO SHOP in order to get or derive benefit from the distribution of literature of this kind as the CALENDAR is attractive enough in every way to promote a feeling of GOOD-WILL toward LOCAL SYSTEMS and the HYDRO in general.

Place your order early to avoid undue pressure when delivery is expected in DECEMBER.

H.E.P.C. SALES DEPARTMENT

A Neglected Instrument of Precision

The Necessity of a Close Study of Language

By T. L. MONAGHAN, B. Sc., (Eng.) Hons., M.I.E.E.

ENGINEERING is neither a science nor an art, but a combination of the two; it consists of collecting and classifying facts about those unvarying successions we call the laws of nature, and applying the knowledge so obtained to practical problems. The engineer finds out how things can be done, then does them as they should be done.

Science is based upon experiment, and fundamentally experiment is measurement; the engineer's aim is to carry principles into practice efficiently, and efficiency is rooted in measurement. The two-fold demand for means of measurement, in investigation and in execution, is liberally catered for to-day; the range of choice of instruments for almost every useful measurement is wide; we have available delicate, sensitive apparatus for the laboratory, robust, almost foolproof appliances for industrial use. The modern engineer prides himself on appreciating to the full the importance of accurate measurements, yet too often he neglects the most vital measurement of all, for who among us "always measures the length and breadth of his assertions"?

Now every assertion has two aspects, the thoughts upon which it is founded, and the way in which these thoughts are expressed. No engineer will admit for a moment that he is not a clear thinker, yet it cannot be denied that some engineers neglect to acquire the art of writing a clear, well-balanced statement. The mental attitude of such a delinquent appears to be: "I have done the work and have no time to waste in pretty writing about it. I would rather not write anything, but if I must write, then I will spend only so much time on it as is absolutely essential for putting the results on paper. Then I will get on with my real work." This attitude is quite a wrong one. In the interests of efficiency it is the duty of the engineer to communicate to his fellows any special knowledge he has acquired, for an engineering problem is not completely solved until the solution is available for the world at large; much useful knowledge fails to be circulated because its possessors decline to grapple with the pen. Again, an engineer is often called upon to give the benefit of his technical knowledge to non-technical people; he should, of course, give them the full benefit of his knowledge, and the extent to which he does so depends very largely upon the way in which his report marshalls the facts, draws up the arguments, and states his conclusions. Ability to express one's views and ideas effectively, and to drive home one's arguments convincingly, is, then, so important that a plea may well be urged for the closer study by the engineer of that most flexible and potent instrument for the measurement of assertions—the English language.

A close study of language is essential to all whose work calls for precision of statement. Language is a most important, if, indeed, not an indispensable, intrument of thought; who does not know that uncomfortable condition when ideas he cannot put into words float elusively in the mind, and the feeling of grasp and possession acquired when the ideas are captured by finding for them appropriate words? Language is the sole vehicle for the communication of all but the simplest ideas; through it we are indeed heirs to all the ages; by it we may attain some small share of immortality, if, perchance, records of our work lessen the labours of those who shall take up after us the search for engineering truths.

Language is used to convery our thoughts, and for our present purpose may be defined as combinations of words; we must consider, then, first words, and afterwards their combinations.

Words in many respects resemble money. Money is a medium of exchange; its value as money is exactly what we agree it shall have, and if the parties to a transaction involving a transfer of money have different ideas as to its worth, then before they can do business they must agree upon a rate of exchange. Now words are the currency of ideas, and there is often a rate of exchange between users of words, though unfortunately this may not be appreciated by the parties to the transaction. To the user a word means what *he* intends it to mean, to the hearer the word means what *he* thinks it means, and unless user and hearer attach the same significance to the word, confusion arises. The careful writer will, therefore, endeavour to ensure that the words he uses to carry his ideas shall convey them without modification, by using ordinary words in their generally accepted senses, and where, as often happens, quite ordinary words have several meanings, he will make clear which of them he has in mind. Cultivate the habit of looking up in a good dictionary all words of whose meaning you are at all doubtful, and soon you will be referring to it for words the meanings of which you once were sure you knew perfectly. Technical terms are intended to express quite definite ideas, but with the rapid growth of scientific knowledge technical language is falling into arrears, and, as a result, some technical terms have more than one meaning, so that almost as much care is needed here as with ordinary language, to see that your words carry your exact meanings. You can take a horse to water but you cannot make him drink, but if you don't take him to the water he won't have a chance of drinking; so that while you cannot ensure that your readers will grasp your meaning, you can at least ensure that the responsibility for failure to do so does not rest on you.

Alive to the importance of selecting his words carefully, the writer now enters upon the task of forming them into proper combinations. We are not concerned here with correctness of grammatical structure, of which a reasonable standard is relatively easy to attain, but with combinations of words in a wider

sense. What is the real aim of all professional writing? Surely it is to carry conviction, to bring others round to our point of view, to persuade them to adopt the course we advocate; in short, to carry our point?

If we are to have any opportunity of doing this, what we write must be read, and being read must be understood. To ensure that it shall be read we must make it interesting; to ensure that it shall be understood we must make it clear. But while different people may be interested in the same thing, they are not all interested in the same aspects of it. The technician is interested in why a thing happens, how a result may be attained, how a difficulty may be overcome; the business man is interested in when a thing can be done, how much it will cost and how much it will save; so that it is necessary first to ascertain the viewpoint of the particular audience we wish to convince. Having decided the general method of treatment which will be best for our special appeal, the next point to decide is the method of approach. If the information we have to convey is such as the audience is prepared to believe if clearly laid before it, then an orderly straightforward method of explanation is best. But it often happens that our findings are likely to be unwelcome to the audience, and considerable care is necessary in such cases. The obnoxious statements should not be made until arguments have been adduced that will convince the audience that the statements must be accepted. When dealing with sceptical audiences there is a natural temptation to let oneself go in demolishing the opposition, but it is wiser merely to show that we are prepared to meet all objections to our arguments; our object is not to compel our audience to admit that its former views were wrong, but to persuade it to admit that our view is correct.

Facility in writing is not to be attained without diligent practice and the cultivation of a spirit of severe self-criticism. No matter how skilful one may be, it is useful in all important cases, if time permits, to put the completed report aside for a while, and to come back to it when the enthusiasm of composition has evaporated. If you do not find much that you will wish to amend, many obscurities where you thought all was crystal clear, you are indeed gifted.

And always remember that what your readers do not understand is useless. There are varieties in methods of expression. There is that of which no man can grasp the author's meaning, that from which an intelligent and persevering reader can unravel some shreds of the author's meaning and that the proud author of which can boldly "deny the ingenuity of man to give to our words any other meaning than that which we ourselves intend them to express." Strive diligently after this last —*The Electrical Review.*

List of Electrical Devices, Material and Fittings

Approved by the Hydro Electric Power Commission of Ontario in July, 1925

Appliances

ALLEN ELECTRIC MFG. CO., 2055 West Lafayette Blvd., Detroit, Mich.

Ford and Universal test stands.

* * * *

THE ASH-TEMPLE COMPANY, LTD., 243 College St., Toronto, Ont.

Dental Engine and Lathe.

* * * *

BEACH FOUNDRY LIMITED, Ottawa, Ont.

"Beach" Electric cooking range, Cabinet type, Style E24A, E34A; Low oven type, Style E13A, E14A.

* * * *

CANADIAN GENERAL ELECTRIC CO. LIMITED, Hotpoint Works Division, Stratford, Ont.

"Hotpoint" Table Stove, Portable, Cat. No. D30.

Floor Type Air Heaters, Portable, Cat. Nos. A33 and A34.

Floor Type Air Heaters, Stationary, Cat. Nos. A35 to A45 incl.

* * * *

THE FITZGERALD MANUFACTURING CO., Torrington, Conn.

Junior Marcel Waver, "Star-Rite."

* * * *

THE GOLD SEAL ELECTRIC COMPANY, 2110-2112 Woodland Ave., Cleveland, Ohio.

"Gold Seal Electric Company" Curling Irons and Marcel Wavers.
Electric Soldering Irons.
Upright Toaster.

GROH REFRIGERATION CO., 48 Abell St., Toronto, Ont.

"Groh" Domestic Refrigerating Machine.

* * * *

SUPERIOR ELECTRICS, LIMITED, Pembroke, Ont.

Electric Flat Irons, Cat. Nos. 10, 12, 14, 20, 22, 25, 26.

Electric Tailors Irons, short model, Cat. Nos. 100 and 120.

Electric Tailors Irons, long model, Cat. Nos. 140, 160, 180, 200 and 220.

* * * *

*DICTAPHONE CORPORATION, (Mfr., Bridgeport, Conn.

DICTAPHONE SALES CORPORATION LTD., (Submittor), 33 Melinda St., Toronto.

"The Dictaphone" Type A, Model 10 (recording and reproducing); Type B, Model 10, (reproducing).

* * * *

*PROMETHEUS ELECTRIC CO., THE, 511 W. 42nd St., New York, N.Y.

Electric Heaters.

Sterilizers, Types Nos. 520, 523, 526.

* * * *

*STANDARD ELECTRIC STOVE CO., THE, 1720 N. 12th St., Toledo, Ohio.

"Standard" Flush wall type Ranges, Model Nos. A-4, A-5, A-7 and A-9.

Cooking and Liquid Heating Appliances.

Ranges, having various combinations of ovens, fireless cookers, and

hot plates. Models Nos. 10, 55, 301, 302, 101-B, 201-B, 350, 365, 400, 419, 421, 423, 450, 455, 501, 519, 523, 550, 555, 590, 601, 619, 619D, 621, 639, 655, 701, 755, 850 and 950.

Griddles, Model Nos. 20, 25 and 60.

Hot Plates, Model Nos. 30, 40, 45 and 50.

Broilers and Toasters, Model Nos. 65, 165.

Bakers' Oven, Model No. 70.

Circulation type Water Heaters, Model Nos. C-6, C-13, C-19, C-26, C-39.

* * * *

*Wood Electric Co., C.D. Inc., 565 Broadway, New York, N.Y.

Christmas Tree Lighting Outfits, Cat. Nos. 300-02 incl., 333-38 incl.

* * * *

Switches

*Mutual Electric & Machine Co., 7610 Jos. Campau Ave., Detroit, Mich.

Knife Switches (As listed on Underwriters' Laboratories card dated June 12, 1925).

* * * *

*Oliver Electric & Mfg. Co., 4221-27 Forest Park Blvd., St. Louis, Mo.

"Safety First" Enclosed Switches. Type SFRA.

* * * *

*Cutler-Hammer Mfg., Co., The Milwaukee, Wis.

Resistance Appliances (as listed on Underwriters' Laboratories cards dated June 5, June 6, 1925.)

* * * *

*General Electric Co., Schenectady, N.Y.

Resistance Appliance (As listed on Underwriters' Laboratories card dated May 8, 1925).

* * * *

Fittings

Harvey Hubbell Company of Canada, Limited, 7 Labatt Avenue, Toronto.

Medium Base Receptacles.

"Hubbell", Metal shell, key socket body, Cat. No. 75.

Medium Base Sockets.

"Hubbell" Key socket body, Cat. No. 75.

* * * *

Hale Bros., 435 St. Paul St., W., Montreal, Que.

Fuseless Attachment Plugs "Halebro".

* * * *

Francis H. Ruhe, 37 Murray St., New York, N.Y.

"R" No. 5 112 porcelain split knobs for use with No. 14 to No. 10 incl., standard rubber-covered wire.

* * * *

*Oliver Electric & Mfg. Co., 4221-27 Forest Park Blvd., St. Louis, Mo.

"Oliver" Receptacles, Types CRA, CRB, CRC, LRA, LRC, SRA, SRC, SRBA, SRBB, SRBC, SRBL, SRBR, Plug Types LP, SP.

3-pole. Types S.P.R.

Lamp Guards. Cat. Nos. HL 15, HLL15, HLS15, HL20, HLL20, HLS20 and HLO.

* * * *

*Magnus Electric Co (Mfr.), 787-795 E. 138th St., New York, N.Y.

Magnus Electric & Radio Mfg. Corp., (Submittor), 787-795 E. 138th St., New York.

Single and double outlet composition base receptacles for attachment

plugs. Cat. Nos. 6T, 161, 162. "Magnus".

* * * *

Lighting Devices

BUSSMAN MANUFACTURING CO., 3819-25 N. Twenty-third St., St. Louis, Mo.

Portable Electric Lamp. "Buss-Clamp-O-Set".

* * * *

DECORATIVE METAL CO., INC., Taunton, Mass.

Portable Electric Lamp. "DMCO".

* * * *

Miscellaneous

*HARRIS & HARRIS CO., 512 Delaware Ave., Toronto, Ont.

Flexible Tubing.

* * * *

*HATFIELD RUBBER WORKS, Hackettstown, N.J.

Flexible Cord.

*BUFFALO FUSE CORPORATION, (Submittor), 752 Main St., Buffalo, N.Y.

CLEMENS ELECTRICAL CORPORATION, (Mfr.), 725 Main St., Buffalo, N.Y.

"Pierce" Renewable Plug Fuses.

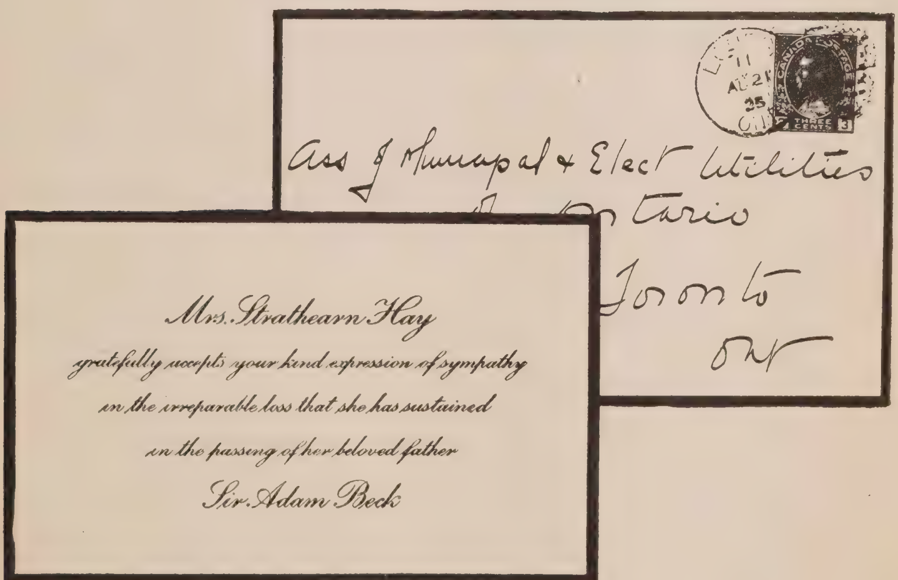
SUPERIOR ELECTRICS LIMITED, Pembroke, Ont.

Pull-off Plug, Cat. No. 92.

Assemblies of Cat. No. 92 plug and 6 or 8 ft. lengths of No. 18, 16 or 14 heater cord for use on heating devices. Cat. Nos. 1000, 1002, 1003 and 1004.

* * * *

*These devices are under the Underwriters' Laboratories re-examination or label service.



THE BULLETIN

Published by
HYDRO-ELECTRIC POWER COMMISSION
of Ontario

190 University Avenue
Toronto

Subscription Price $2.00
Per Year

An Unusual Tribute

THE following letter and clipping from Col. C. F. Hamilton, Royal Canadian Mounted Police, to Mr. C. A. Magrath, Chairman of the Commission in reference to Sir Adam Beck, fully explain themselves:

"Ottawa, 17th September, 1925."

Dear Mr. Magrath:

I send with this a cutting of a compliment to Sir Adam Beck, which is quite out of the ordinary. It is from the "*New Leader*", an aggressively socialist (but non-communist) weekly, published in New York. It occurred to me that those interested in Sir Adam Beck are not likely to notice this particular tribute. I do not know any of them, and so send it to you.

With best wishes,

Yours sincerely,

(*Sgd*) C. F. HAMILTON.

"A GREAT PUBLIC SERVANT"

"Sir Adam Beck is dead. Canada, to quote the Toronto Globe, has lost "the greatest constructive mind in the public life of the country". The world has lost the most versatile and successful advocate, builder, and administrator of a publicly owned super-power system to be found in any nation. Sir Adam Beck's life story was, in part, the life story of dozens of successful self-made men. But with this difference. He used his extraordinary power not primarily to build up his personal fortune or to obtain paternalistic control over his fellows, but to create effective machinery for the public ownership and operation of an immense public utility. His life presented some interesting paradoxes. The head of the Commission which built the greatest hydro-electric power plant in the world and organized a system of distribution in which

CONTENTS

Vol. XII. No. 9
SEPTEMBER, 1925

386 local governments were partners with the Province of Ontario was not an engineer but a manufacturer, originally in a small way, of wood veneer and cigar boxes. The brilliant and slashing advocate of public ownership, the target of incessant attacks by private power interests, was not a Labor man or Socialist, but for years sat in the Provincial Parliament as a Conservative. The finest tribute Ontario can pay to Sir Adam Beck will be to carry on."

A Mighty has Fallen

Sad events sometimes o'ertake us
In the passing of the years—
Sorrows quite so universal
That a nation sheds her tears,
Far o'er hill, on plain, in valley
Grief unbidden now holds sway
For our well beloved Sir Adam
Has by death been called away.
In the cabin and the mansion
Hearts are bowed in bitter grief,
As our nation sadly mourneth
For our far famed "Hydro Chief."

His has been a life of service
Such as few men ever gave,
And with record that's unsullied
He will fill a statesman's grave,
For the weal of all the people
And for honesty he stood;
So the hearts which beat correctly
Bear him deepest gratitude.
And on tablets which great nations
Dedicate to men of fame,
Many coming generations
Will inscribe Sir Adam's name.

—MACK

London, Ont., August 17th, 1925.

Charles Alexander Magrath

Chairman, Hydro-Electric Power Commission of Ontario

FEW public appointments in the province of Ontario have occasioned more genuine and widespread interest than has the appointment of a new Chairman to the Hydro - Electric Power Commission of Ontario.

When the news was published on the 12th of September, 1925, that the Ontario Government had selected Charles A. Magrath for this important position there was, on the part of the general public, a recognition that an appointment had been made irrespective of political influence and all sections of the public press testified to the satisfactory character of the appointment, and complimented Premier George H. Ferguson and his Cabinet on their excellent choice.

Charles A. Magrath

In the selection of Mr. Magrath, it is evident that a choice has been made of one who has had valuable training and possesses special experience in public affairs and who, as Chairman of the Canadian section of the International Joint Commission, — the organization that administers the Boundary Waters Treaty between Great Britain and the United States, —has been in close touch with many phases of problems affecting international waters that are of vital interest to the province of Ontario. Moreover, it is known that Mr. Magrath in the past has manifested sympathy towards the work of the Hydro-Electric Power Commission and has referred in terms of generous appreciation to the great work accomplished on behalf of the

public by the Commission's greatly-lamented Chairman,—Sir Adam Beck. On the day he entered upon his new duties as Chairman of the Commission, Mr. Magrath graciously paid a tribute to the work of his predecessor, the first and only Chairman of the Commission.

"No one", said Mr. Magrath, "regrets more than I do the circumstances which have brought about my appointment, that is the death of Sir Adam Beck who who built up this great project. It is rather early for me to make any statement as to policy but I suppose I am justified in saying that the target to shoot at is what Sir Adam had in mind. That is the development and putting to use of every feasible source of power for electrical energy to be distributed throughout the municipalities of this province.

"I assume that this is the target, though my colleagues are in a better position than I to define it precisely. I am here to join them in loyally carrying out the principles for the development and enlarging of this great public undertaking according to the purpose of the late Chairman."

It will be interesting to review briefly some of the outstanding features of Mr. Magrath's career.

Charles Alexander Magrath was born on the 22nd of April, 1860, at North Augusta, Ontario. His parents were Bolton Magrath and Laura (M'Phee) Magrath. The father of the new Chairman was a native of the North of Ireland and about the middle of last century settled in Canada, where he married Laura M'Phee, who was Canadian born of Scottish descent. Later the family moved to Aylmer, situated on the Quebec side of the upper Ottawa valley, and here the new Chairman spent his early boyhood.

Mr. Bolton Magrath was a man of brilliant talents, and was specially gifted in mathematics. Before emigrating to Canada he had been an astronomical computer in an Irish Observatory. He was enthusiastic in his desire to impart knowledge to others and while in Aylmer employed much of his time in teaching. He was for a time Inspector of Schools. In those days in Canada there was relatively little remuneration for educational work and Charles A. Magrath, after having received a good grounding in mathematics, left home at a comparatively early age, to begin his work as a surveyor and engineer. In Gard's history of the "Pioneers of the Upper Ottawa", there is recorded an interesting comment by the Hon. Frank R. Latchford, now Chief Justice of Ontario. Speaking of the many professional men who have come from Aylmer and its vicinity, Mr. Justice Latchford gives great credit to the educational work of Mr. Bolton Magrath and states:

"Many of us revere his name, for to him do we owe more than we could tell. He was the most thorough teacher I ever knew. He had the rare ability to bring out all that there was in a boy. He inspired him to do his best. He was a wonderfully clever mathematician. . . . You have doubtless remarked the large number of surveyors from Aylmer.

Well, most of them may thank Bolton Magrath for their start in life. The interest he took in the boys was wonderful. If any of them were to go to Quebec to pass their examination, this old teacher would spend nights with them perfecting their papers. I will warrant that not another set of papers ever went to Quebec as those that went from Aylmer. No wonder we boys love to think of him in after life. He was our friend when we were boys."

Charles Magrath went to the Northwest Territories in 1878 with Colonel J. S. Dennis, who was in charge of the Dominion Land Surveys for the Department of the Interior, and for seven years Mr. Magrath was engaged in the survey of lands of the Northwest. He was with the first Dominion Government Survey to establish the geodetic stations from the third to the fifth meridians. In his earlier years he entered whole-heartedly into western activities. He learned to perform such feats as toting a pack, driving a dog team and conquering a cayuse, and in his travels back and forth became familiar with the great and lesser rivers of the West,—the Saskatchewan, the Red, the Assiniboine and the Bow.

Mr. Magrath, himself a western pioneer, came into personal contact with many who were earlier pioneers than himself and who have contributed so greatly to the development of the Canadian Northwest. These pioneers included Charles Mair, William Pearce, Colonel J. S. Dennis, Sir F. W. G. Haultain, Sir Augustus Nanton, George W. Allen, and, of course, Sir Alexander T. Galt.

It is little wonder that a young man associated with such experiences as were characteristic of the West in those early days should partake so largely of the "Western spirit". "I can't get the West out of my blood and I hope I never will", said Charles A. Magrath. "I like a young country as I like young men. I always try to keep the viewpoint of youth".

In 1887, Mr. Magrath married Margaret Holmes Mair, a daughter of Richard Holmes Mair. Mrs. Magrath died in 1892, leaving a young son, Charles Bolton Magrath. Mr. Magrath's son is a talented engineer and is now with a prominent engineering firm in the United States. He served during the Great War in the Canadian Artillery, where the mathematical endowments received from his forbears, along with other talents, enabled him to render special service that was recognized and highly commended by his superiors.

In 1899, Mr. Magrath married Mabel Lilias Galt, daughter of the late Sir Alexander T. Galt, C.G.M.C., one of Canada's most distinguished sons, and one of the Fathers of Confederation. Mr. and Mrs. Magrath have two daughters, Amy Gordon and Mabel Laura.

Before tracing the later activities of Mr. Magrath's professional career it is appropriate to record that he is what is known as a "D.T.S.", that is, a Dominion Topographical Surveyor,—the highest rank of surveyors in the Dominion. He is also a Provincial Land Surveyor, as well as a Dominion Land Sur-

veyor, holding the certificates and degrees of P.L.S., D.L.S., and D.T.S.

Mr. Magrath was endowed with business capabilities and it was natural that the opportunities which presented themselves to a young man in the West should have led him to progress from the somewhat restricted field of surveying to paths offering more scope to his abilities. Consequently, in 1885 he became associated with the activities of Sir Alexander T. Galt and his partners who were the pioneers in the development of southern Alberta, particularly the district surrounding and south of the city of Lethbridge. In order to appreciate the work of Mr. Magrath in the West a brief reference is necessary to the pioneer work of Sir Alexander T. Galt.

It was the coal lands and the possibilities of their development in connection with the Canadian Pacific Railway, then being pushed west from Winnipeg and east from the coast, that interested Sir A. T. Galt. In 1881, Galt drove from Assiniboine River to Alberta, a distance of 700 miles, to inspect the "coal banks". An expert mining engineer from Nova Scotia was engaged to report and his report being favorable, four locations were, in 1882, leased from the Government. A company was organized known as the Northwestern Coal and Navigation Company, with William Lethbridge as president.

Developments at this time were rapid in the west. In 1881, the first great cattle ranch was established and the era of the steer replaced the reign of the buffalo. In 1885, the Northwestern Coal and Navigation Company, having experimented with navigation on the rivers and found it useless for their purpose, built 110 miles of railway to connect its coal lands with the Canadian Pacific Railway, and thus secure a market for coal. In 1885 Lethbridge was planned and staked out. In 1886 the Canadian Pacific Railway was completed from coast to coast.

Markets in Canada for the coal did not materialize as hoped, and in 1889 the Alberta Railway and Coal Company was formed,—absorbing the Northwestern Coal and Navigation Company,—with the object of building a railway to connect with United States markets.

In building its various railways to market coal the Company, by government lands granted in aid, became almost as interested in land as in coal. But its lands were poor and unattractive without irrigation. Consequently, the thoughts of Galt and his associates turned to the possibilities of irrigation.

In 1892 the Alberta Railway and Coal Company was given the right to construct irrigation works and a year later a separate company, the Alberta Irrigation Company, was chartered for this purpose.

The years 1890 to 1900 were dark days for the West, and especially for the interests of Galt and his associates. About 1897 the tide turned; the Dominion Government assisted by remitting certain survey dues; the Canadian Pacific Railway assisted by donating funds and, inspired by the unwavering faith of Sir Alexander T. Galt, further Brit-

ish capital was forthcoming. Negotiations were entered into with the Mormons who had had valuable experience in irrigation in the westerly United States, and finally a contract was entered into for the construction of certain irrigation works.

Now, throughout most of this period Charles A. Magrath had been actively associated with the son of Sir Alexander T. Galt—Mr. Elliott T. Galt—who was general manager and afterwards president of the western enterprises established by his father. In 1885, Mr. Magrath became land agent for the Northwestern Coal and Navigation Company, and later land commissioner for the Alberta Railway and Coal Company. Subsequently, about 1897, he was appointed manager for the Alberta Irrigation Company. The negotiations with the Mormons, leading up to the actual construction of the irrigation works, were carried on mainly by Mr. Magrath.

From 1900 the tide in the affairs of the Company definitely turned and success was rapidly achieved. The pioneer work of the Galts, father and son, and their associates, was followed by the efforts of others, notably the Canadian Pacific Railway, and abiding prosperity came to the lands men had once regarded as desert. It has been stated that Mr. Magrath is considered "to have done more to develop what are called the sub-arid districts of Alberta than any other man in the west". He retired from the irrigation company at the end of 1906.

During the period of his association with the coal and irrigation companies, Mr. Magrath took an active part in the governmental and political activities of the great West. He was elected by acclamation first Mayor of Lethbridge upon its incorporation in 1891. He was then living in Lethbridge, and in 1892 was elected a member of the Territorial Assembly of the Northwest Territories, which met at Regina. At three elections he was returned by acclamation to the Territorial Assembly from which he retired in 1898 shortly after his appointment as manager of the Irrigation Company.

In 1908, Mr. Magrath, somewhat reluctantly, found himself in the Dominion House of Commons. He had been in the East while his friends in Alberta were considering his candidature as representative for the constituency of Medicine Hat. Mr. Magrath did not see his way clear to accept the nomination, but as he has stated, "I was in the East and wired a refusal. The wire, they said, went astray. When I returned I found it impossible to withdraw. The old timers would not let me out". He represented Medicine Hat as a Liberal-Conservative until 1911, when, along with his party, he opposed the Taft-Fielding Reciprocity Agreement. This stand resulted in his being defeated for Medicine Hat. Referring to this incident, Mr. Magrath has said: "My old friends all treated me with every consideration, but many told me very frankly they could not vote for me on that issue".

In June, 1911, Mr. Magrath went to England as one of the representatives of the Canadian House of

Commons at the Coronation of King George and Queen Mary.

Mr. Magrath's entrance into federal affairs has afforded an opportunity for him to render signal service to the Canadian people.

When the Boundary Waters Treaty between Great Britain and the United States was made effective, Mr. Magrath, in 1911, was appointed as one of the first members of the International Joint Commission, the organization constituted under the terms of the Treaty for its administration. Three years later, Mr. Th. Chase Casgrain,—the Commission's first Chairman of the Canadian Section—retired to become postmaster general, and Mr. Magrath was appointed to the vacant position. At the time of his appointment as chairman of the Hydro-Electric Power Commission, Mr. Magrath was still Chairman of the Joint Commission, a fact which testifies to his impartial attitude, because he received the same consideration from a Liberal Dominion administration as from a Conservative one.

In 1913, Mr. Magrath was appointed Chairman of an Advisory Commission created by the Government of Sir James Whitney to report upon a comprehensive system of highways for the province of Ontario. This Commission, in its Report of 1914, outlined the general programme upon which the extensive highway improvements made by the Provincial authorities are based.

Mr. Magrath's education did not terminate with his leaving Aylmer. Being of a studious and contemplative turn of mind, he has prosecuted research into various subjects intimately related to Canadian development. In 1910 he published a book entitled "Canada's Growth and Some Problems Affecting It". His interest in economics, immigration and other problems, as well as his singleness of purpose to serve the public, have resulted in Mr. Magrath's being selected for several important public trusts. During the dark days of the Great War, Mr. Magrath was a member of the War Trade Board and of the Patriotic Fund Executive. He is also President of the Victorian Order of Nurses of Canada.

One of the most difficult and exacting commissions placed upon Mr. Magrath was in connection with his position as Dominion Fuel Controller, to which he was appointed in 1917. The Canadian authorities and public have not forgotten—and it is believed they never will—the able service Mr. Magrath rendered in connection with Canada's fuel shortage. To his tact and untiring efforts during this stressful period is largely due the fact that Canada relatively suffered as little as she did. Mr. Magrath's knowledge of Washington conditions, gained during his years of service on the International Joint Commission, enabled him quickly to establish the contacts and assurances with the Washington Fuel Administration necessary to an adequate consideration of Canada's position. He has spoken in the highest commendation of the courtesy and practical aid rendered Canada by the United States authorities during this trying fuel shortage period. In 1922, Mr.

Magrath became a member of the Federal Advisory Fuel Committee of Canada.

Mr. Magrath has never waned in his interest in the development of the West. His practical knowledge of Western conditions was employed by Premier Greenfield of Alberta when, following a five-year drought in southern Alberta, Mr. Magrath, in 1920, was appointed Chairman of a special Commission to investigate and report upon the agricultural conditions in southern Alberta with a view to their improvement.

A review of Mr. Magrath's public activities reveals the fact that he has been guided more by principles than by the proclamations of political parties. In an interview published on the fifteenth of September, 1925, Mr. Magrath said he had advised people to make "bonfires of worn out political clothes" and he added, "you may make me say there will be no politics in Hydro if I can help it".

Of late years his work has largely been of an advisory character. In his new position as directing head of the Hydro-Electric Power Commission of Ontario, Mr. Magrath will not only be able to advise but also to direct and create. He will find that measures which are for the advancement of the Commission's work in the general public interest are largely within the power of the Hydro-Electric Power Commission to carry into effect. The Commission as a great administrative organization has been endowed by Government with large authority and power. It was always a matter of prime concern with Sir Adam Beck that the Commission's staff should be maintained upon the most competent and efficient basis and those familiar with the late Chairman's utterances know upon how many occasions he turned aside from some theme he was presenting in order to emphasize the fact that he attributed to the staff of the Commission the consummation of the various undertakings upon which the members of the Commission have passed. In the sphere of international problems where are involved other interests such, for example, as the St. Lawrence development, Niagara power, and the Chicago diversion, Mr. Magrath's years of experience in such problems should prove of special value to his colleagues as well as to the safeguarding and furthering of the Commission's interests.

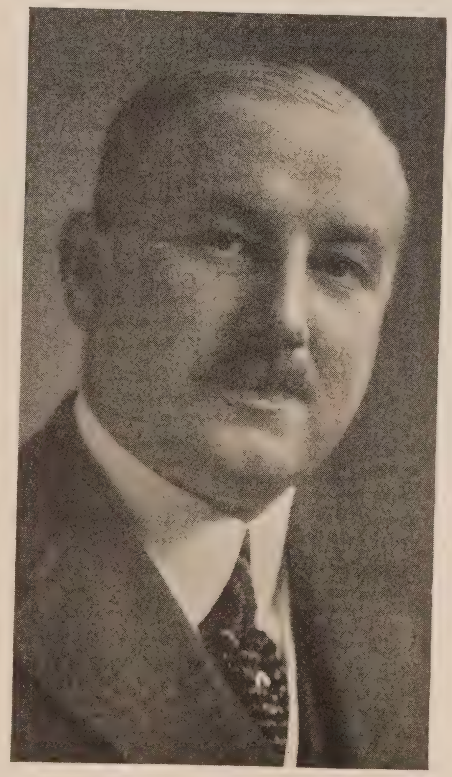
In pledging himself as he has done to safeguard and give further expression to the great principles upon which the whole municipally-owned, electrical undertaking of the province of Ontario is based, Mr. Magrath and his colleagues on the Hydro-Electric Power Commission will have behind them the hearty support as well as the intelligent and unstinted co-operation of the staff of the Commission of which Mr. Magrath is now the honored head.

Charles Alfred Maguire

Commissioner, Hydro-Electric Power Commission of Ontario

THERE are no public organizations in Ontario that have a membership more representative of the intelligent and resourceful business men of the Province than have the Ontario Municipal Electrical Association and the allied organization of the Association of Municipal Electrical Utilities. One has only to attend a conference of these representatives to perceive that all are keenly alive to the interests of the municipalities they represent.

The organizations just mentioned have, for a number of years, been urging the Government of the Province to appoint to the Hydro-Electric Power Commission of Ontario a Commissioner who would be specially fitted to represent the municipalities with respect to such features as they may regard as of special importance. The Government of the Province, with a deliberation that sometimes characterizes governments in introducing innovations, proceeded cautiously, but latterly intimated its readiness to grant this special request of the municipalities. Now, throughout the period that the municipalities have been pressing for representation, one man has been mentioned by the municipal representatives as especially acceptable to them. This man is C. Alfred Maguire.



C. Alfred Maguire

There has been in the minds of the representatives of the municipal hydro-electrical utilities ample justification for their recommendation of Mr. Maguire. It has been recognized that he has

had an extensive public experience and is well versed in municipal affairs. He has served eight years on the municipal council of the City of Toronto and four more years on the Board of Control. In 1922, by acclamation, he was elected by his fellow citizens to the highest office they can bestow—the position of Mayor of Toronto. This was the first occasion when a Mayor of Toronto was elected by acclamation for his first term. He served two terms as Mayor and then voluntarily retired from civic office. There was, however, another factor prominent in the minds of the municipal Hydro representatives. It had become evident to all that Mr. Maguire well understood the broad principles upon which the great municipally-owned electrical undertaking was based, and that he possessed a keen appreciation not only of what would advance its interests but also of what might constitute a menace to its successful development.

Few men have been more alert than Mr. Maguire in raising emphatic protest against any movement or suggestion that had within it the possibility of injuring the great municipally-owned enterprise. The important part taken by the municipality of Toronto in the early days of the initiation of the Hydro undertaking will be recalled. During later years, due to the magnitude of its interests, Toronto has continued to be a source of strength to other hydro-electric utilities and in this connection Mr. Maguire has, throughout his public career, stood as a staunch and consistent supporter of all that he believed to be for the welfare of Hydro municipalities. Nor have his interest and sympathy been confined to his own city; he has spoken in many places throughout the Province on behalf of Hydro enterprises.

On numerous occasions, when matters affecting the welfare of the work of the Hydro-Electric Power Commission were under special consideration, Sir Adam Beck brought Mr. Maguire into conference, because the late Chairman counted upon Mr. Maguire's intelligent and firm support to advance the cause of public ownership and the development of the hydro-electric resources of the Province.

An understanding of Mr. Maguire's qualifications such as those briefly referred to above, will explain the very favorable comments generally expressed by the daily papers following the announcement by Premier George H. Ferguson of the appointment of the new Chairman and the new Commissioner to the Hydro-Electric Power Commission. It will be recalled that the press of the Province referred in generous terms to the well-merited appointment of C. Alfred Maguire. What the representatives of the municipalities had known for years has also become widely recognized by the public and to this favorable sentiment the press gave due expression.

In the statement Premier Ferguson issued in connection with the new appointments occurs the following passage:

> "Mr. Maguire has been for many years one of the foremost advocates of the public development of power, and, moreover, has acquired

an intimate knowledge of the work of the Power Commission. He has, in fact, been largely instrumental in seconding the efforts of Sir Adam Beck to bring the undertaking to its present situation. The fact that Mr. Maguire has, from time to time, occupied important positions in the municipal organizations concerned with power development has pointed to him as specially fitted to represent the municipal interest on the Commission."

Two or three representative comments of the press may be cited:

"Ontario may deem itself fortunate, therefore, in the Government's choice of Messrs. Magrath and Maguire. . . . . . Mr. Maguire has built an enviable reputation upon his record of civic service to Toronto and his unfailing loyalty to and intimate knowledge of the huge Hydro-Electric project. . . . . Both men were born in Ontario, and will bring to the discharge of their duties not merely the industry and enterprise which their careers have shown them to possess, but an abiding regard for the welfare of their native Province."—*Toronto Globe.*

"Mr. Maguire is an enthusiastic public ownership man and always a strong supporter of the policies of Sir Adam. . . . . His selection will have the approval of the municipalities of the province, whose champion he has been on many occasions."—*London Free Press.*

"About Mr. Maguire's enthusiastic support of the Hydro project there can be no doubt; he has been one of its sturdiest champions. And as he is the choice of the Ontario Municipal Electric Association for a commissionership, he can be regarded as in a special sense the representative of the municipalities on the commission."—*Hamilton Herald.*

The *Canadian Engineer* expressing the viewpoint of the engineering profession respecting the "Ontario Hydro Appointments" stated, with reference to Mr. Maguire, that his "record as a public servant of outstanding ability well entitles him to the appointment as the third member of the Commission".

Charles Alfred Maguire was born in the city of Toronto on the 24th of May, 1875. His father was James Maguire, an Irishman who emigrated to Canada when eighteen years of age, and there married Miss Elizabeth Brown, a Canadian. In 1900, Mr. Maguire married Miss Lillian Cusack of London, Ontario. He has one son, Herbert Alfred Maguire.

After completing his education in the Toronto schools, Mr. Maguire entered the employ of Messrs. John MacDonald and Company, the well-known wholesale dry-goods firm of Toronto. Later, he was associated with the late Colonel George Higginbotham in the City of London Fire Insurance Company. Subsequently, Mr. Maguire joined the Lancashire Fire Insurance Company, and when this Company was acquired by the Royal Insurance Company, he went

to the Royal, where, in association with his colleague, Mr. William Connon, he has under the firm name of "Maguire and Connon" been, for twenty-two years, general agent for Toronto and vicinity.

Notwithstanding the heavy demands of business, Mr. Maguire has been able to render special service to his native city, and as already pointed out, in 1909 became a member of the Municipal Council of Toronto, and thereafter remained in the public service of the City for fourteen years, and until his voluntary retirement at the termination of his second term as Mayor.

It is a common experience that adequate recognition is seldom given to those who take a public stand on behalf of some principle, even though such stand be in the public interest. Especially is this so when such a stand may be out of harmony with important influences that, at the moment, may be prevailing. Those who have observed the municipal career of Mr. Maguire recognize that on more than one occasion and when it was difficult to do so, he did not hesitate to take strong and appropriate action. Moreover, when called upon to justify his position he was able to demonstrate that sound principle had governed his course.

An interesting incident may be cited as illustrative of Mr. Maguire's concern for the public welfare. In the fall of 1922, when the whole city of Toronto had prepared a public reception for Mr. Lloyd George, it was at a late hour announced with governmental authority that Mr. Lloyd George would be unable to enter into the arrangements of the day. Mr. Maguire, while fully recognizing that the city of Toronto would readily forego any pleasure it had anticipated rather than jeopardize the health of its looked-for guest, was unwilling to proclaim to the citizens that they could not see Mr. Lloyd George, until he, as mayor and chief representative of the city, had obtained from Mr. Lloyd George his personal assurance that he understood the facts but had been compelled to absent himself from the arrangements of the day. Mr. Maguire went early to the station, saw Mr. Lloyd George in his private car, and learned that he had not rightly understood the facts. Later, the distinguished guest went through the whole programme of the day, including his address at Massey Hall, and Mr. Maguire never received more hearty thanks than those from Mr. Lloyd George, who expressed in generous terms his appreciation of Mr. Maguire's insistence that all the facts should be known to him,—a knowledge which soon transformed what would have been a very regrettable public incident into a day of great satisfaction to all concerned.

With his extensive experience in municipal affairs, possessed of the confidence of Ontario municipalities, with a long and intimate understanding of the municipally-owned hydro-electrical undertaking, it is believed that C. Alfred Maguire is eminently fitted to justify the Premier's appointment, as well as to render to his colleagues on the Commission and to the municipali-

ties that have contributed to his appointment, an intelligent and efficient service.

With Mr. Charles A. Magrath as Chairman, equipped with his long public experience and familiarity with problems appertaining to international waters; with Hon. John R. Cooke, with his legislative experience, the confidence he enjoys from the Ontario Government, and his special experience gained during his years of service as a Hydro Commissioner, and with Mr. C. Alfred Maguire, with his understanding of, and loyalty to, the municipally-owned hydro-electric undertaking, his knowledge of the needs of the municipalities and his extensive public experience, it may be said of a Commission composed of these native sons of Ontario that such "a three-fold cord is not quickly broken".

Lightning Strikes Radio Aerial

By F. K. D'Alton, Assistant Laboratory Engineer, H.E.P.C. of Ontario

THE following paragraphs furnish an account of the first instance which has come to our notice where lightning has struck a radio receiving aerial, resulting in serious damage to property.

This occurred on May 23 last, at 8.30 a.m.; when the home of Mr. E. C. Monkman, near Brampton, Ontario, was partly destroyed.

The aerial ran approximately east and west and consisted of a single conductor, supported at the west

Fig. 1. Residence of Mr. Monkman after lightning stroke.
(1). Location of chimney and west aerial mast.
(2). Location of east aerial mast.
(3). Location of water tanks in attic.

Fig. 2. East end of building showing splintered aerial mast.

Fig. 3 North-east corner of building showing splintered mast and eaves.

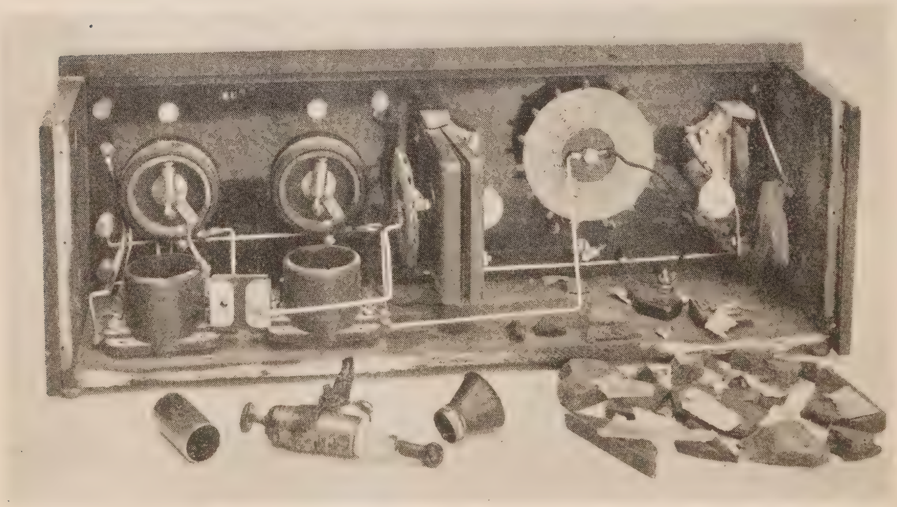


Fig. 4. Radio Receiver, damaged by lightning. Note that the condenser exploded but the coil was not damaged. The coil would have formed a by-pass for a low frequency surge.

end by a chimney and at the east end by an upright wood mast. (Fig. 1.) The lead-in wire came down to a point near the eave trough and then entered the house through a side window.

At some distance from where the lead-in wire came down, two metal water tanks were located in the attic of the house. Feed pipes to these water tanks were enclosed in a wooden box which was filled with sawdust to prevent the pipes from freezing.

Lightning evidently struck the mast at the east end (Fig. 2 and 3) and followed three paths. By one path it split the mast, as far down as the guy wires, then followed one guy wire to the eave trough, splintering the cornice, ran along the eave trough to the down spout and then to the cistern.

A small part of the stroke followed the metallic path down the lead-in wire to the arrester and receiver. The arrester evidently functioned but did not save the set. In the receiver (Fig. 4) the first variable condenser was blown to pieces but the spiderweb coil, which bridged the gap, was not injured in any way. This is evidence of the high frequency of current in the lightning surge.

The disassembled arrester is shown in the left foreground of Fig. 4.

By another path the stroke followed the aerial conductor a short distance to a point above the overflow pipe of the water tanks, struck down from the aerial to this pipe and was conducted to ground by the feed pipes of the tanks, setting fire to the shavings surrounding these pipes.

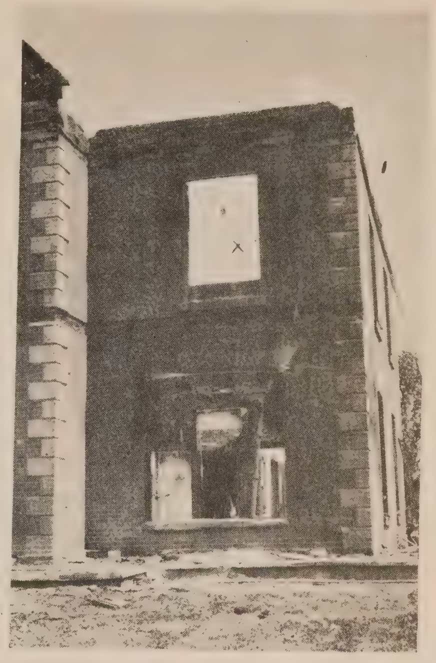


Fig. 5. North-west corner of building: part gutted by fire, showing roof burned off and water pipe remaining standing inside building.

(x). Top of east aerial mast appearing through window.

(1). Location of chimney.

Considerable disturbance was caused in the water in the pipes, forcing the sediment from the traps of the system into the sinks and basins in the house.

The tanks were enclosed in a small attic room and smoke was first seen coming from this room through the eaves of the house. The room was found to be filled with the flames.

The main part of the house was gutted; (Fig. 5), the rear part of the house, however, over which the aerial apparently was struck, was saved by volunteer help.

This radio receiver had been carefully installed by a local electrician. All precautions were taken in the insulation and grounding and an approved type of lightning arrester was properly connected between the lead-in wire and the lightning ground.

The radio receiving installation was quite modern. All usual precautions were taken in the insulation and grounding, and a standard type of lightning arrester was connected, outside the building, between the lead-in wire and a lightning-rod ground.

The lightning stroke in this case, however, was a direct stroke of tremendous power, and the ordinary types of arrester can not be expected to fully protect equipment against so severe a flash. Fortunately, instances of damage done by heavy direct strokes are very rare, it usually being found that the so-called stroke has been merely a secondary voltage induced by the main stroke, which occurred at some distance, or possibly only between two clouds.

This accident, while very regrettable on account of the great loss sustained by the owner, has given us valuable information by reason of the peculiar behavior of the lightning. It is seldom an opportunity is afforded for studying the effects of lightning in such great detail.

In order that this subject may receive the attention which its importance warrants it is requested that any instances of trouble with lightning on radio equipment be reported promptly to the Chief Electrical Inspector of the Commission (26 Queen St. East, Toronto 2).

The Interference Muddle

By W. J. Williams

MOST people wonder why radio should be so noisy. They forget that most of the applications that engineers have recently made of the findings of science to the solution of our everyday problems have produced considerable noise. For instance, most of us can remember in the early days of the automobile industry how noisy the automobiles were.

Similarly with radio, a number of noises we encounter are perfectly natural and show a healthy development.

The "Noise Level"

After we have eliminated the unnecessary noises we cannot expect to have a "zero noise level", or in other words, no noise at all. We must always bear in mind that wherever we have electrical energy there is a possibility of producing an electro-magnetic disturbance which will produce noise in a receiving set.

The interference problem is thus seen to be theoretically simple, whereas practically, it is a very difficult one, owing principally to its size.

Our Problem Explained

A complete solution of the interference problem requires consideration of the social aspect and also the psychological reaction of the individual radio listener. The principal social groups affected are the radio broadcasters, the radio manufacturers and retailers, the radio audience and those government departments which have supervision of radio broadcasting.

The Listener

Before taking up the individual radio listener's reaction to interference we will have to consider some of the characteristics of this interesting person.

Those of us who were interested in opening broadcasting station WHAZ found that we did not know the psychology of the radio audience. I am going to tell you some of the things we found out.

A large proportion of the working time of most persons is devoted to mere routine and sometimes even to drudgery. This means that in order to be reasonably happy most people have to find outside of their work some means of satisfying those desires which they cannot fully satisfy through their work. The instincts of wonder, admiration and even reverence can be and are satisfied by radio.

The artistic instincts find satisfaction in many different ways in radio, from the construction of a radio set to the artistic enjoyment of the programs received.

The Self-Made Expert

It must be known to all of you that the amateur scientist finds himself in clover when he enters the radio field. This type of radio listener is hard to handle when a case of interference arises. He is usually successful in making a satisfactory receiving set but should he have a set which is noisy, it is almost impossible to convince him that the noise originates in his set and does not originate in some external source.

This type of radio listener always makes me think of the country doctor. This doctor was driving home one evening when he was stopped by a farmer who asked him if the young boy up the road had smallpox. The doctor pulled up his horse and said that he had not yet decided. The farmer replied, "My mother-in-law says he has smallpox."

"Well," said the doctor, "has your mother-in-law ever had smallpox?"

"No," said the farmer.

"Has she ever nursed a case of smallpox?" inquired the doctor.

"No," said the farmer.

"Well, has she ever seen a case of smallpox?"

"No," said the farmer, "but that don't make no difference to my mother-in-law."

We found that if a speaker criticised anything feminine, even in a joking manner, our telephones would soon begin ringing.

Unless we recognize the strength of these personal appeals we cannot understand why the listener is so utterly unable to understand the relative importance of broadcasting and the other electrical utilities.

Public Utilities Deserve Fair Play

I wish you would picture in your imagination what civilization would be without any one of these public utilities. Would you be willing to go without the advantages you now have through the facilities placed at your disposal by the electric light and power company, the telephone and telegraph company, the railways and the electric railways which serve the community in which you live? No sane person would be willing to make this sacrifice.

I want you to take, in your imagination, a large map of the United States and draw upon that map all the important transmission lines used by the electric light and power companies, telephone and telegraph companies, railways, and electric railways. Then take a map of your county and put on this map all the electric lines in the county. Next take a map of your city and put on this map all the electric lines threading the city streets and buildings and try to add to this last map all the apparatus in your city which uses electrical energy. Add to this picture you have of these three maps the fact that a disturbance at any one point can affect receiving sets at great distances from the source and you will begin to realize the enormous number of possibilities there are for producing radio interference.

The Cure

We come now to a general outline of the method which must be followed by the interference engineer. Do we find that nature has evolved a human ear which is infinitely sensitive and which can be affected by waves of all frequencies? Most certainly not.

We hear sound waves between the frequency limits of approximately 100 and 15,000. No sound waves outside these limits produce the sensation of sound. If a sound wave is too intense the ear does not recognize it as sound, but as pain. If the sound wave has an intensity below the threshold value it will not be heard. The lower limitation prevents us from being disturbed by all those small noises which are of no practical importance to us. For instance, if our ears were infinitely sensitive how could we sleep, if we had to listen to the footsteps of all the flies within a hundred miles? I think you will agree with me that nature has been very kind as well as wise and that we cannot do better than apply nature's method to our radio problem.

Radio broadcasting must function under this same kind of limitations. The lower frequencies are already used by our power and transportation systems. The intermediate or audio frequencies are now used by our telephone systems. Many of the frequencies which might be available for radio broadcasting are already used by our commercial radio telegraph companies, the government and radio amateurs.

These radio services are at present considered social necessities. All this means that radio broadcasting must be carried on between perfectly definite frequency limitations.

The other limitation, which is the more important, is that of the power which broadcasting stations shall use. If we allow a large variation in power we make it extremely difficult to design and construct receiving equipment which can be operated by the average radio listener. We, in Troy, have experienced more trouble from this source than from any other in the whole field of radio broadcasting.

Radio listeners have constructed for themselves or bought, so-called supersensitive sets with which they hope to hear the Pacific coast and European stations. It has been our experience that it is impossible for the majority of these people to receive either the distant or the nearby stations satisfactorily.

If the radio listeners require the public service corporations operating in their territory to reduce the noise level produced by them they would require these corporations to spend vast sums of money in changing equipment, improving insulation, etc. Eventually the public, which includes the broadcast listeners, would have to pay for these improvements. It is, therefore, necessary to establish a reasonable lower power level. Then if any particular broadcast listener wishes to construct or buy a sensitive receiver, which will receive programs below this lower level he should do it with the knowledge that he is placing a symphony orchestra in a boiler shop.

The High Power Nuisance

With regard to the upper power limit for broadcasting stations, there is room for considerable difference of opinion. Our experience in Troy has convinced us that there is no necessity for these so-called "super-power" broadcasting stations. When something of national importance is being broadcast, it can be done very satisfactorily by linking several 500 watt broadcasting stations (chosen on account of their location) together by line wires.

Nothing can do more toward solving the interference difficulty than an educational campaign for the purpose of getting these facts honestly and fairly before the public.

What Is Being Done

The National Electric Light Association, ever since its attention was called to this matter, has been collecting information on the subject from all over the country. Almost all light and power companies are turning over to this association complete data regarding their experience, in the matter. This information is being very thoroughly studied by a committee created expressly for this purpose. Any information which this committee is able to get out of the data they receive, which will help in any way to prevent trouble or locate trouble which already exists, is sent out by it to all the operating companies. I believe at the present time they have the matter well in hand and that we have every reason to expect that unnecessary noises from this source will rapidly disappear.

The American Telephone and Telegraph Company is doing practically the same thing. They are gathering

information through the telephone operating companies and when this information is thoroughly digested at headquarters, they are sending out information to the associated companies, which will enable them to forestall troubles or locate and eliminate the cause of troubles which may already exist.

I think that you will agree with me that these other interests who have to use the same medium as you do when you are receiving broadcasting programs, are doing everything they reasonably can be expected to do to give you the undisturbed use, for broadcast reception, of this common medium.—*Q.S.T.*

Appliance that lie on the Shelf, Tra-La, Have Something to Do with the Case

JUST for the fun of it, someone ought to take the time to make a thorough survey of the homes within a supposedly electrified area, the sole objective of that survey to find out:

"How many electrical appliances are there on closet shelves or in the attic of so-called electrified homes —that is, homes wired for electricity? and

"WHY ARE THEY THERE?"

As in all good O. Henry stories, the "kick" is in the last line. "Why are they there?" Indeed, yes.

Is it because the home has no convenience outlets, and that the appliance,—by the time a globe is screwed out of its socket, a double plug screwed in, amid encircling glassware—is really an electrical inconvenience? Then the remedy is to be sought in making electricity painlessly accessible, through modern wiring.

Is it because consumption of electricity is feared, lest the bill be too high? Then it is convenience and cleanliness that must be sold.

Is it because the appliance has been over-rated to the customer and, having been "stung", as he thinks, he does not want to use it? Then his misapprehension must be allayed and his confidence slowly built up to par.

It may be because the housewife is a creature of habit, old-fashioned, one who just will not adjust herself to the use of the labor-saving device, preferring to use the methods of her grandmother. Her case is almost, but not quite, hopeless. She is a hard and unyielding customer, but persistence in the demonstration of its usefulness may win her in the end.

Or is it that most subtle of reasons, the hardest to discover and the simplest to remedy? Something has gone wrong with the appliance. Maybe the insulation on the cord has worn out, something as simple as that. The cord shorted and blew a fuse. In fear, the housewife, feeling that she has somehow done something wrong, calls the power company, vaguely saying that the lights

have gone out. Meanwhile she has stowed the offending appliance on the closet shelf or up in the attic lest the trouble-man discover it when he arrives, and blame the trouble on that particular iron or percolator. Maybe she has had a previous experience with a gruff chap who made a remark something like this, "Were you using that thing? No wonder she blew."

Anyway the appliance has gone on the shelf, and it will probably stay there for several weeks, or months, before she will venture, furtively, to bring it out again and hook it up to the line. All that time the appliance is a dead loss to the central station.

The matter of servicing appliances is a delicate one. It is ground that a suggester treads upon lightly. But as long as the appliance lies on the shelf unused for want of intelligent and courteous servicing, it might as well never have been sold. It is a potential source of revenue that has been hidden away. Moreover, it is pretty apt to be an influence which makes that housewife timid about buying any new or different type current-consuming device—another potential source of revenue dammed up.

The appliance that lies on the shelf, tra-la, is an important point in the case. The sale of an appliance is not complete when it is merely put on the line. It must be kept on that line to be really sold.—*Journal of Electricity.*

Fatalities From Electric Shock by Climbing Poles

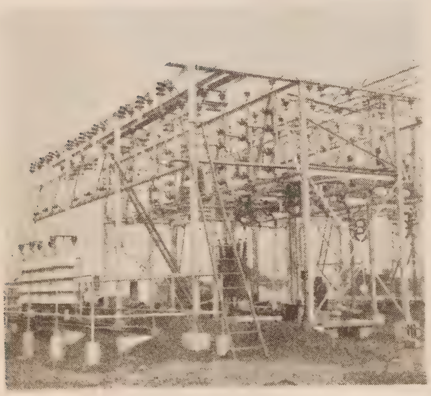
Within the short space of less than a week three fatal accidents occurred on the Toronto Hydro System by the victims climbing poles carrying high voltage power lines. These accidents all happened recently and the circumstances warrant our comment on the situation. It is hoped that the seriousness of these occasions and the cause of them can be the better realized by all.

In two instances young boys were retrieving kites which had become entangled in the high voltage transmission wires. An employee of the Humane Society climbed a pole to rescue a cat marooned on the top among 13,000 volt wires on the other occasion. In each case the poles were stepped with the usual precaution of having the bottom step not readily accessible.

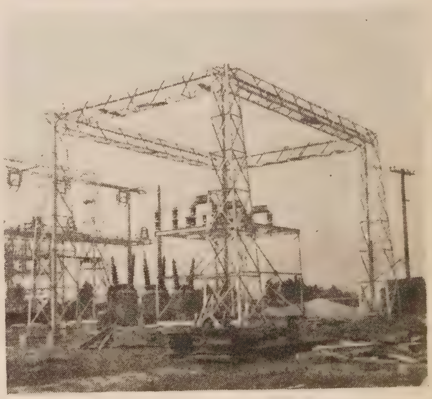
Various suggestions and comments have been made in the daily press with the intent of insuring the safety of the public from the reoccurrance of such accidents. A red band painted around the bottom of the pole; removal of steps from the poles and warning signs on the poles are some of the suggestions discussed in the daily press.

The Commission has been greatly concerned over the numerous electrical accidents and is ever putting forth effort to reduce these to a minimum. The public is not generally aware of these efforts. In addition to literature circulated warning the public and bulletins placed in conspicuous locations, demonstrations are conducted periodically on resuscitation and safety first principles.

The above shows the possibility of overbuilding a thoroughfare with a steel tower line. On our York to Strachan Ave. 110 kv. line now building, we found it necessary to locate this 4 circuit tower practically on the road at the east end of the Exhibition Park and consequently made use of this particular design of tower



St. Clair transformer station at Sarnia,Ontario. 26400 volt switching structure under construction.



St. Clair transformer station at Sarnia, Ontario. Outdoor 110,000 volt structure under constuction.

On the new 4 circuit line entering Toronto the locatation was such as to necessitate overbuilding a number of houses. The above is just west of Dowling Ave. and is a typical example.

Port Arthur Bare Point transformer station where power is stepped down from 110 to 22 kv. for distribution around Port Arthur. The building contains control room, transformer erection room, service equipment rooms and an operator's apartment. The 110 kv. banks of transformers are outdoors. It was placed in service in August, replacing the temporary station that had been operated nearly five years.


1926 January 1926
1 2
3 4 5 6 7 8 9
10 11 12 13 14 15 16
17 18 19 20 21 22 23
24/31 25 26 27 28 29 30
1926
1
7 8
14 15
21 22
28
1926 March 1926
1 2 3 4 5 6
7 8 9 10 11 12 13
14 15 16 17 18 19 20
21 22 23 24 25 26 27
28 29 30 31


1926 April 1926
1 2 3
4 5 6 7 8 9 10
11 12 13 14 15 16 17
18 19 20 21 22 23 24
25 26 27 28 29 30
1926 May 1926
1
2 3 4 5 6 7 8
9 10 11 12 13 14 15
16 17 18 19 20 21 22
23/30 24/31 25 26 27 28 29
1926 June 1926
1 2 3 4 5
6 7 8 9 10 11 12
13 14 15 16 17 18 19
20 21 22 23 24 25 26
27 28 29 30


1926 July 1926
1 2 3
4 5 6 7 8 9 10
11 12 13 14 15 16 17
18 19 20 21 22 23 24
25 26 27 28 29 30 31
1926 August 1926
1 2 3 4 5 6 7
8 9 10 11 12 13 14
15 16 17 18 19 20 21
22 23 24 25 26 27 28
29 30 31
1926 September 1926
1 2 3 4
5 6 7 8 9 10 11
12 13 14 15 16 17 18
19 20 21 22 23 24 25
26 27 28 29 30


1926
1 2
8 9
15 16
22 23
29 30
1926 November 1926
1 2 3 4 5 6
7 8 9 10 11 12 13
14 15 16 17 18 19 20
21 22 23 24 25 26 27
28 29 30
1926 December 1926
1 2 3 4
5 6 7 8 9 10 11
12 13 14 15 16 17 18
19 20 21 22 23 24 25
26 27 28 29 30 31

Artificial Illumination of Poultry Houses for Winter Egg Production

Abstracted by G. G. Cousins, Illumination Laboratory, H.E.P.C. of Ontario

THE use of artificial light for the increase of egg production has been recognized for some years and many poultry keepers, amateur and otherwise, have dabbled with light in a more or less cut-and-try method with varying results.

Following is some practical information on the subject, abstracted from Cornell Extension Bulletin No. 40.

The fact that the use of artificial light has been found in some instances, to stimulate winter egg production by as much as 70 per cent, has brought up the question as to what intensity is conducive to maximum production. The answer to this was obtained only after an extended investigation covering a period of two years. As a result of observations carried on jointly by the department of Rural Engineering and the Department of Poultry Husbandry of the New York State College of Agriculture, it was found that the illumination necessary for active feeding should be in the neighborhood of one foot-candle. It was also discovered that besides the illumination on the feeding area, it was quite essential that there be sufficient direct light on the perches, in order that the birds would not have a tendency to roost there.

The use of a standard 40 watt, clear, Mazda B lamp, with cone-shaped reflectors, 16 inches in diameter at the base, by 4 inches high, with reflecting surface of aluminum bronze, hung six feet above the floor and spaced 10 feet apart was found to meet the requirements.

In lighting the pen, the poultryman has at his disposal three different types of light: extending the morning light, morning and evening light, or evening light alone.

So far as production goes, each method produces satisfactory results if other conditions of management are correct. Artificial morning light is used extensively, because it is the cheapest to install and lends itself readily to inexpensive, automatic control by a time clock. However, the extra cost of installation for evening light is small, and with this installation any method of handling may be practised. Whatever the method, the bird should have a 12 or 13 hour day.

It has been determined that the lights may be turned on suddenly without affecting the birds, but that turning the lights off suddenly makes it very difficult for the birds to go to roost.

In order to bring about a practical way for dimming the lights, the poultryman has at his disposal three different wiring systems, which are commonly known as:

1. The resistance unit system.
2. The two circuit system.

3. The series parallel system.

A full explanation of each system being given in the text.

In the concluding pages of the bulletin, data is given as to where control devices may be obtained, and the matter of the operation of poultry lighting with reference to the farm lighting plant is taken up. The bulletin is profusely illustrated with cuts which bear out the statements contained in the text, and really tends to prove beyond a doubt the outstanding features of the bulletin. Wiring diagrams for all of the above-mentioned circuits are also shown in a very simple and practical manner.

Worthy of Note by Utilities' Employees

One of the great business houses conducted a survey on employment conditions with the purpose of finding out why some men are failures, according to the Southern Public Utilities' Magazine. Of some 300 persons who had been discharged by the firm during the term of the survey 30 per cent were dropped for "lack of industry". In other words, there was a streak of laziness which prompted them to neglect their duties.

Sixteen per cent were freed because of their refusal or inability to follow directions. Twelve per cent of the discharged employees were let out because they were conspicuously lacking in courtesy and tact. In the business and industrial world politeness is a distinct asset. Grouchy manners will get a man nowhere—except into jail or trouble.

Eight per cent were described as being without sufficient "stick-to-itiveness" to justify their continued employment. They were perhaps courteous, tactful and competent, but they did not take an active hold upon their tasks. They were mechanical in their performance. They did not put their hearts into the business.

Another eight per cent lost their positions because they could not beget or inspire confidence. They were disposed to be tricky. There were few out-and-out crooks in the whole list and the house has an enviable reputation for the character of its employees. The figures showed that a man who is courteous, competent, industrious and ambitious is reasonably certain to obtain recognition in any business or industry and almost certain to in this.

—*Electric Light and Power.*

Re. Municipal Populations

To enable The Bulletin to give as nearly as possible the correct populations of the Hydro Municipalities as shown in the lists on the inside of the cover, it would be of considerable assistance if the Municipal Officials advise of any corrections that should be made.

—Editor.

Hydro News Items

Central Ontario System

The Colborne Rural Power District, which includes the hamlets of Grafton and Wicklow, is now in operation. There are some 56 consumers taking service. This district is served from our Colborne sub-station.

* * * *

The Department of Public Works has just completed a large institution known as "The Boys' Training School" at Bowmanville. This institution is completely equipped electrically and includes a large electric kitchen installation. Part of the cost of the building and equipment has been met by several of the well known social service organizations, such as the Rotary Club, the Kiwanis Club and others. At present this institution only takes light but will eventually take a load of about 250 h.p.

* * * *

A valuation of all existing lines outside the limits of the City of Peterborough has been prepared by this Commission and rates have been estimated for all consumers outside the city limits. These lines are at present operated by the Peterborough Utilities Commission.

* * * *

Extensive changes in the switching arrangements of the Oshawa sub-station are nearly complete.

Georgian Bay System

Arrangements have been completed for doubling the capacity of the outdoor sub-station at Greenbank, a 150 kv-a. 3-phase transformer being replaced with a similar type of unit of 300 kv-a. capacity. This change is necessary on account of the increase in load at Uxbridge, Port Perry and the Mariposa Rural Power District, all of which are served from this station.

* * * *

The Commission is proceeding with the construction of an addition to the sub-station at Owen Sound in the nature of an additional bank of transformers, the total capacity of which is 1,500 kv-a. As soon as this work is completed, the sub-station at Owen Sound will have a total capacity of 3,150 kv-a. The additional sub-station capacity at Owen Sound is required to take care of the growing load in this City, particularly the new terminal grain elevator recently constructed.

* * * *

Service has been recently given to the Sparrow Lake Rural Power District, the principle load centres of which are the Hamlets of Washago and Severn Bridge, located about three miles distant from the Wasdell Power House. It is expected that these lines will be extended next year into the summer resort district in the vicinity of Sparrow Lake, a

large number of contracts at this location having already been secured.

* * * *

The Town of Midland has recently completed an installation of an ornamental "white-way" on its main street, having at the same time removed all primary lines in this location to side streets. The installation consists of 36 ornamental standards, each unit being equipped with 500 watt lamps.

* * * *

The Commission has recently completed a new switching structure at Waubaushene to take care of the tie line between the Muskoka and Severn divisions. These improvements will greatly facilitate the operation of all of the lines on the Georgian Bay System, particularly to municipalities in the northern section of same.

* * * *

The various extensions to the Muskoka Development recently undertaken by the Commission have been completed, including changes at the head works, new pipe lines, two new generating units and an additional bank of transformers. Full load has been carried on all these units and the Commission has been able to transmit to the Severn System 3,200 kw. over the new tie line between the Development and Waubaushene. The second portion of the changes at South Falls, viz: Hanna Chutes Development, located about one-half a mile above the main plant, is progressing favorably, the dam having been completed and the Power House work is well under way. It is expected that the Hanna Chutes unit, which will be controlled from the main station, will be in operation about the 1st of the New Year.

* * * *

Niagara System

The new 110,000 volt wood pole line from St. Thomas to Sarnia will be ready for operation sometime during the month of November.

The 110,000 volt transformer station at Sarnia is now practically completed and will be ready for the heavy winter load.

* * * *

New 26,400 volt lines are being constructed from Essex H.T. station to Windsor, the present lines being inadequate to carry the rapidly increasing load.

* * * *

Arrangements are being made to construct an outdoor type sub-station near Kleinburg to take care of the Bolton load, and the rural load in that district. The station will consist of 3-150 kv-a. transformers. Bolton and this district are at the present time being supplied from the Commission's station at Woodbridge at 4,000 volts.

* * * *

A new sub-station is being arranged for near Mitchell consisting of 1-150 kv-a. outdoor type three phase transformer, and also at Tillsonburg the Commission has plans for a new sub-station consisting of 3-75 kv-a. single phase outdoor type transformers. Both of these stations are to take care of the loads in the rural power districts.

* * * *

Port Dover is at the present time supplied with power over a 4,000 volt line from Simcoe, and owing to the rapid growth of load in that Municipality, arrangements are being made to extend the 26,000 volt line to Port Dover and erect an outdoor transforming station having a capacity of 300 kv-a. The existing 4,000 volt line will be retained in order to have a low tension tie between the station at Port Dover and Simcoe.

* * * *

Owing to improvement work carried out by the Harbor Board, it has been necessary for changes to be made in connection with the 110,000 volt line entering the City of Toronto. A new four circuit steel tower line has been erected to replace the original two circuit line. The conductor is 605,000 cir. mils A.C.S.R., the four circuits having a normal capacity of 250,000 horsepower. The towers are extremely heavy, and since the line is in such a prominent location, the design was altered to conform to an "Eiffel" effect, to give a more pleasing appearance.

* * * *

St. Lawrence System

The Council of the Township of Russell has forwarded a resolution requesting information on the cost of service to rural residents, including the Police Village of Embrun.

* * * *

The Police Trustees of Metcalfe have requested estimates on the cost of power in conjunction with the supply to the Police Village of Russell.

* * * *

On August 18th, the ratepayers of Russell carried by large majorities, the by-laws to authorize the Trustees entering into an agreement with the Commission for a supply of power and to erect a distribution system. It is proposed to supply Russell in conjunction with Metcalfe and Embrun, from a 4,000 volt line from Chesterville.

* * * *

An extension is under way and another extension is proposed to supply rural residents in the Martintown Rural Power District.

* * * *

Thunder Bay System

The Commission has recently completed the installation of a new outdoor transformer station at Bare Point for the purpose of serving the City of Port Arthur. This station constitutes the last word in construction of 110,000 volt outdoor type, and is similar to the Wiltshire and Bridgeman Street station in the City of Toronto. The total capacity at the present time is 30,000 kv-a, with provision for installing an additional bank of transformers, which will bring the ultimate capacity of the station up to 45,000 kv-a.

* * * *

Construction on number 5 unit in the Nipigon Power House has advanced to a point where it has been turned over by its own turbine.

A.M.E.U.
Minutes of Meeting of Executive Committee

A meeting of the Executive Committee was held at the office of the Hydro-Electric Power Commission of Ontario, on Wednesday, September 9, 1925, being called to order by the President, Mr. V. S. McIntyre, at 2.30 p.m. Others present were Messrs. R. J. Smith, R. H. Starr, W. R. Catton, O. H. Scott, C. A. Walters, J. G. Archibald, J. E. B. Phelps, J. R. McLinden, H. G. Hall, G. J. Mickler, C. A. Maguire, T. J. Hannigan, and S. R. A. Clement, Secretary.

This meeting was called for the purpose of considering a proposed memorial to Sir Adam Beck, and also for a preliminary discussion of plans for the Winter Convention of the Association. Messrs. T. J. Hannigan and C. A. Maguire outlined a proposal that had been made to inaugurate a campaign throughout the province to establish an endowment fund for the Byron Sanatorium, to be called The Beck Sanatorium, the fund to be known as The Beck Sanatorium Endowment Memorial. It was explained that the campaign would be carried out by the Sanatorium Board, who desired the support of all interested organizations in the province. After discussing the proposal at some length the following resolution was adopted—

Moved by Mr. W. R. Catton,
Seconded by Mr. R. J. Smith,

THAT the Executive of the Association of Municipal Electrical Utilities (of Ontario) approves and endorses the suggestion of the Campaign Committees *re* Beck Sanatorium Endowment Memorial and offers the Committee our support and co-operation in their campaign for this purpose.

CARRIED.

The Secretary was instructed to send a copy of this Resolution to the Sanatorium Board.

Mr. Hannigan reported on the progress made by the Superannuation Committee. The replies *re* employees had come in satisfactorily and that sufficient had been received on which to base an actuarial report. It was desired, however, to have the report based on 100 per cent of the employees and an effort would be made at once to get replies from such towns as had not been heard from. It is expected to have the actuarial report ready for submittal at the Winter Convention.

The Winter Convention of the Association was next discussed. The Secretary referred to the invitation that had been received from London to hold the convention there. In that the Association had established the rule of holding the Winter Convention at Toronto, it was deemed desirable that the practice should be continued. It was, therefore, agreed that the next convention will be held at the King Edward Hotel, Toronto, on January 27th and 28th, 1926. The Chairman of the Convention and Papers Committees were instructed to proceed with the preparation of plans for this convention and have everything ready to report to the Executive at its next meeting, which will be held on November 4th.

The Chairmen of the other committees of the Association wer

instructed to bring in written reports at the Winter Convention.

The meeting adjourned at 4.00 p.m.

List of Electical Devices, Material and Fittings

Approved by the Hydro-Electric Power Commission of Ontario in August, 1925.

Appliances

CANADIAN WESTINGHOUSE COMPANY, LIMITED, Hamilton, Ont.

Stationary Electric Low Oven Ranges, Types H-2, HS-1, HS-2; cabinet type ranges, Types W, WA, WS.

"Westinghouse."

* * * *

HOBART MANUFACTURING CO., 173 King St. E., Toronto.

"Hobart" Electric Meat Choppers; Cake Mixers; Food Cutter.

* * * *

THE McCLARY MANUFACTURING CO., London, Ont.

Portable, Fireless Electric Cooker.

* * * *

DURABLE ELECTRIC APPLIANCE CO., 81 Jarvis St., Toronto.

Reflector type Electric Air Heaters.

Stationary, Bathroom type Electric Air Heaters, Cat. No. 106.

* * * *

NORTHERN ELECTRIC COMPANY, 2835 North Western Ave., Chicago, Ill.

"Northern Service" Curling Irons, Types 55 and 77; Soldering Iron, No. 9.

* * * *

ONWARD MANUFACTURING COMPANY, LIMITED, (Submittor), Kitchener, Ont.

EUREKA VACUUM CLEANER COMPANY, INC., (Mfr.), Hamilton and Dewey Avenues, Detroit, Mich.

"Eureka" Portable Electric Vacuum Cleaner.

* * * *

RUSSELL ELECTRIC COMPANY, 340 West Huron St., Chicago, Ill.

Electric Curling Irons, Cat. Nos. 3, 5, "Flapper", "Flapper Special".

"Rex" Electric Waver.

* * * *

Fittings

*HART & HEGEMAN MFG. CO. THE, (Submittor), 342 Capitol Ave., Hartford, Conn.

PAISTE CO. H.T. (Mfr.), 3201 Arch St., Philadelphia, Pa.

Receptacles for Attachment Plugs & Plugs (as listed on Underwriters' Laboratories card, dated July 24, 1925).

* * * *

*PASS & SEYMOUR INC., Solvay, N.Y.

Receptacles for Attachment Plugs, Cat. Nos. 1510, 1520. "P. & S."

* * * *

*UNION ELECTRIC CO., (Mfr.), Trenton, N.J.

A. L. WYNSTON, JR., LIMITED, (Submittor), 77 York St., Toronto.

"U.E.Co." Fuseless Rosettes, Cat. Nos. 763-68 incl.

Switches

Canadian General Electric Company, Limited, Peterborough, Ont.

Auto-Transformer Starters.

Type C.R. 1034 hand-operated Compensators.

Type C.R. 7052A and C.R. 7052A2 Automatic Compensators.

Type C.R. 7052 B1 Automatic Compensators.

* * * *

Moeller Switch Box Bars Company, (Submittor), 59 Dundas St., London, Ont.

Taylor Electric Mfg. Co., Limited, (Mfr.), 526 Adelaide St., London, Ont.

Support for Switch Boxes. "T.E."

* * * *

*Allen-Bradley Co., Milwaukee, Wis.

Semi-automatic starter for polyphase motors, Type H-1852.

* * * *

*General Electric Co., Wiring Supplies Division, (Mfr.), Bridgeport, Conn.

Canadian General Electric Company, Limited, (Submittor), King and Simcoe Sts., Toronto, Ont.

Combination Snap Switches and Fuses, Cat. Nos. 27682, 61179, 88984, GE116, GE933. Special fuse 3 amps, 600 V., Cat. No. 28839.

Door Switches, Single-pole, "G.E." Cat. Nos. GE273-74, GE244802.

Fixture Switches, Single-pole, "G.E." Cat. Nos. GE559, GE562.

Pendant Switches, Single-pole, Push, "G.E." Cat. Nos. GE558, GE565, GE683, GE1301, GE1584.

Surface Switches (As listed on Underwriters' Laboratories cards, dated March 24, 1925, and August 3, 1923).

Surface Snap Switch Sub-bases, porcelain. Cat. Nos. 60938-39, GE-761.

Miscellaneous Switches, Tumbler Type, Cat. Nos. 218910, 219528, 219529.

* * * *

*Mutual Electric & Machine Co., 7610 Jos. Campau Ave., Detroit, Mich.

Enclosed Switches (As listed on Underwriters' Laboratories cards, dated July 8, July 9 and July 10, 1925).

* * * *

*Trane Co., The, La Crosse, Wis.

Automatic Switch, Float Type.

* * * *

*Textile Machine Works, Reading, Pa.

Oil Break Switch, Non-Automatic.

* * * *

Lighting Devices

Canadian Kodak Co., Limited, Toronto, Ont.

Safelights and indirect light boxes of sheet metal—portable type.

* * * *

The Pairpoint Corporation New Bedford, Mass.

Portable Electric Lamps. "Pairpoint" or "P" enclosed in diamond.

* * * *

Roman Statuary Co., 551 Richmond St., London, Ont.

Portable Electric Lamps. "R.S."

* * * *

*These devices are under the Underwriters' Laboratories re-examination or label service.

THE BULLETIN

Published by
HYDRO-ELECTRIC POWER COMMISSION
of Ontario

190 University Avenue
Toronto

Subscription Price $2.00
Per Year

Courtesy Pays

IN speaking to the *Bulletin*, the new Chairman of the Hydro-Electric Power Commission of Ontario, Mr. Charles A. Magrath, said: "Practically my first introduction to my duties in connection with this great hydro-electric undertaking came in the form of a letter from a friend in another country who had recently been shown through one of our large generating plants. In his letter he speaks about a place where 'terrific forces are brewed with a strange absence of noise of fuss', and states how fortunate he and his party considered themselves to be guided through the intricacies of the plant by a young man whose 'knowledge of technique and ability to explain were only equalled by his perfect manners and tact.' "

"I have always heard", continued Mr. Magrath, "of the loyalty of the employees of this great organization—an organization, as I understand it, that bends all its energy to the rendering of efficient service to the people of the province of Ontario. The Commission itself and the staff have a common object, and I know that all employees will appreciate what a great pleasure it is to me personally to find myself associated with them in this work, and to have received at the outset such a splendid testimonial, which ended up with 'if your staff are all of this quality you have a fine team'."

Visit of Delegation from Irish Free State

AMONG the recent visitors to the Commission was a delegation from the Irish Free State in the persons of the Honourable Patrick McMilligan, Minister for Industry and Commerce, and the Honourable Gordon Campbell. The Irish Free State is proceeding with a hydro-electric development on the Shannon River, the power to be generated and distributed under State control. The object of the visit was to study the plan followed by the Commission, looking for suggestions that might be applied to their development.

It was explained that during the war, German Engineers came to Ireland and advised that the power development on the Shannon River was quite a feasible proposition, though apparently little mention was made of the economic side of the question of development. Contracts have been let for the construction of the necessary dams, canals and concrete work in connection with the initial power development in which it is proposed to install three units of 30,000 h.p. each. The report, under which the development is being made, states that the plant may be increased up to a capacity of 150,000 h.p. by the installation of additional storage on the river.

It was stated that the total consumption in the Free State at the present time, including power supplied by privately and municipally owned plants is 55,000,000 kilowatt hours per year, or approximately 17.5 kilowatt hours per capita. It is estimated that the output of the first installation of 90,000 h.p. will be 110,000,000 kilowatt hours per annum, and the delegation considered that within a few years, the consumption per capita could be increased sufficiently to consume all of the power generated by this development.

The head under which the plant will operate is 98.5 feet and the estimated cost of the work to be done under the contracts already let is \$10,000,000 to \$12,000,000. Contracts for the generating station, equipment, transmission lines, transformer stations, distribution systems and other plant must be added to this amount. The estimated cost of power generated in this plant at the bus bars is 0.84c per kilowatt hour, and at Dublin, Limerick and Cork transformer stations at 110,000 volts, 1.06c per kilowatt hour.

After the interview at the office the delegation went to Niagara Falls and inspected the Queenston-Chippawa development.

CONTENTS

Vol. XII. No. 10
OCTOBER, 1925

Beck Memorial Endowment.

The Queen Alexandra Sanatorium

NEARLY twenty years of amazing activity, productive of results that find no parallel in Ontario's history, have left in the minds of the people of this province, a picture of the late Sir Adam Beck, as the incomparably resourceful and aggressive leader of a great popular, though commercial cause; a dynamic power whose last ounce of courage, enterprise and capacity were expended in the one great work of Hydro.

With municipal ownership as his wand he tapped the rock of fame, though not of self-aggrandizement; banded together in mighty strength the people of more than 300 communities; and created as servant of the people, and the pulse of which, the colossal electric generating and distributing systems of the Hydro Electric Power Commission of Ontario, in which more than a quarter of a billion dollars have been so successfully invested.

To the public at large, to parliamentarians, leaders of industry, financiers, newspaper editors, in fact to nearly all with whom he came in contact, he was distinguished as the founder of hydro, the "hydro knight."

Possibly because these great commercial activities dominated his career few, until his death, caught a glimpse of the other Beck: still the human dynamo, still the tireless public servant, but in this different field a Beck of the tenderest and most compassionate character, the friend of the poor and afflicted, the leader of another great crusade—the war against tuberculosis.

Between fifteen and twenty years ago, when Sir Adam, then recently elected to the legislative assembly, had struck his strenuous stride in the campaign for the establishment and development of the Niagara power system his most intimate friends became aware that a great shadow had darkened his domestic

Reception Hospital.

Children's Preventorium.

life. Not long afterward he and Lady Beck left with their little child for Europe, hoping that through the aid of eminent specialists and far off sanatoria the threatened health of their daughter might be restored.

Therein was providentially sewn the seed of a phase of Ontario's war against tuberculosis that has since been acclaimed with fervent appreciation by actually thousands of sufferers, and by the great international, national and provincial organizations banded together in the war against the white plague.

Sir Adam spared no resource at his command to expel the grim invader from his own household, but his magnificent propensity to serve his fellow man forbade him to stop when his own end had been achieved.

Though burdened with the great public responsibilities which he had assumed in the establishment of the Hydro Electric Power System, he organized a group of associates in a new body to bring to the people of Ontario all that science has achieved in combatting tuberculosis.

The strings of his own purse were generously unloosed and with contributions running high in the thousands of dollars both he and Lady Beck inaugurated the movement that has since spread its manifold benefits to the people of practically every county and every district of old and new Ontario.

Therein was the genesis of Queen Alexandra Sanatorium for the Tuberculous, an institution serving the whole of the province, which today represents an investment of more than three quarters of a million dol-

New Pavilion.

lars, and an actual value far in excess of that amount.

With the same genius for swift achievement that marked his leadership of the hydro movement, Sir Adam, as president of the sanatorium expanded its capacity and its usefulness. Time after time he poured into its building and maintenance funds, contributions in the tens of thousands, reaching an aggregate exceeding his whole salary from the hydro chairmanship for years on end.

New buildings sprung up as the victims of the dread disease flocked in increasing numbers to gain the benefits of this great institution. More new buildings enlarged the scope and usefulness of the Queen Alexandra Sanatorium during the war, when hundreds of Canada's gassed and health-wrecked heroes returned from the battlefields of France and Belgium. Always, it seemed, still greater pressure from those in need, yet never anything but an eager hand to suffering men, women and children.

First the administration buildings, and a series of "shacks" formally opened by Earl Grey, then Governor General of Canada, on April 5, 1910.

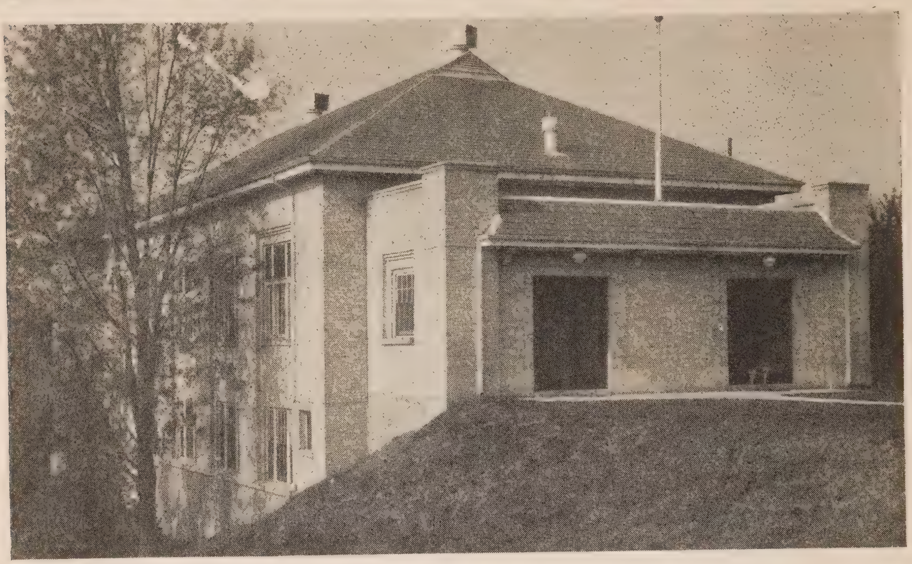
Next the Preventorium, for children threatened with tuberculosis, opened June 4, 1914 by Sir John S. Gibson, then Lieutenant Governor of Ontario.

Then the great, model reception hospital, officially opened January 21, 1918, by the Duke of Devonshire, then Governor General of Canada, and the Vocational Training School and recreation auditorium opened in the following July by Sir James Lougheed, as Minister of the Department of Soldier's Civil Re-Establishment.

Next a large capacity model paviion provided especially to minister to tuberculous soldiers who returned to Canada in the final period of the war and in the post-war demobilization years.

But perhaps of greater interest than the rest, was the Marion Beck Nurses Home, provided as the gift

Marion Beck Nurses Home.



Vocational Hall.

of Sir Adam and Lady Beck. Sir Adam's death recalled to many one of the incidents of the hydro knight's career which revealed in striking manner the tender and compassionate aspect of his dynamic nature.

Sir James Lougheed and other distinguished visitors to the sanatorium had officiated, in the presence of some thousands of people, at the opening of new buildings provided for the reception of disabled soldiers from overseas, while Sir Adam and Lady Beck had gone to participate in a little incidental ceremony at the new nurses' home. In the presence of a comparatively small group Sir Adam ascended the steps of the main entrance, and with Lady Beck at his side undertook to read the formal deed of gift. To the great surprise of those who were familiar with Sir Adam's competence on the public platform, his strong voice quavered, tears came to his eyes and as he read the single sentence of the simple document his emotions overwhelmed him and he was unable to go on. In that dramatic moment Lady Beck stepped to his side, took the document from his hand, and in tense and trembling tones read on:—"given in gratitude to God for the complete restoration to health of our daughter who was threatened with a serious illness."

Even to those most intimately associated with Sir Adam in his work on behalf of the tuberculous of Ontario this was the first intimation of the circumstance that drew him to the support of this philanthropic cause.

When, under the burden of multifold public services, his health failed and he learned at John Hopkins Hospital in Baltimore that a fatal illness had seized him, Sir Adam's interest in sufferers from tuberculosis became intensified. A few weeks before he had undertaken personally to raise an endowment fund to in-

sure, as he so often said, that the doors should never be closed against any poor sufferer from tuberculosis.

With every brief accretion of strength he wrote to his friends and associates in Ontario urging them on to the completion of this great humanitarian effort.

Then from his death bed the stricken knight of the people laid upon all who acknowledge an appreciation of his great service to his province, the obligation not to falter in this appealing cause.

To those at his bedside not long before his death Sir Adam with all the earnestness his failing strength could muster, gave voice to his one great regret. "I had hoped," he said, "to live to see an endowment fund provided for Queen Alexandra Sanatorium. To the people of Ontario I entrust those poor sufferers from tuberculosis, who in their affliction turn to my beloved 'san' for help. Never close the door against them."

Responding to that injunction the province-wide organization which has undertaken to raise the $500,000 Beck Memorial Endowment will conduct an intensive canvass throughout Ontario from November 20 to November 28.

His Honor Col. Henry Cockshutt, Lieutenant Governor of the province, who is an officer of the Canadian Association for the Prevention of Tuberculosis, has accepted the honorary presidency. Hon. G. Howard Ferguson and W.E.N.Sinclair, leader of the provincial Liberal opposition likewise are actively enlisted in the vigorous headquarters organization, ranking as honorary vice-presidents.

Mr. C. A. Magrath, Sir Adam's successor in the chairmanship of the Ontario Hydro Electric Power Commission, has accepted another of Sir Adam's great responsibilities in assuming the chairmanship of the provincial committee. Mayors and civic officials, men and women prominent in the life of Ontario in every part of the province have joined in the great crusade, determined that Sir Adam's dying wish shall not be denied, and as Mr. Magrath has stated, that Ontario shall honor the memory of her great champion in taking up his fight on behalf of sufferers from tuberculosis.

Summarized statements of Queen Alexandra Sanatorium since its establishment afford proof of the hard truth that the victims of the white plague in many cases languish under the double burden of disease and poverty. Every third man, woman and child admitted to Queen Alexandra Sanatorium since its inception has been unable to pay even the bare cost of treatment. Approximately 1,400 sufferers have been taken in and given the benefit of the most advanced treatment science has yet devised, though they have been unable to offer any other return to the association than their prayerful thanks. In this manner deficits of $163,716.07 have been incurred in operating, but under the presidency of Sir Adam Beck such deficits were never the occasion of any great dismay. Now however that Sir Adam's post has been vacated by death the endowment becomes an essential if Ontario's war against the white plague is to be carried on.

Children taking the Sun Treatment.

Since the first announcement of the formation of the organization to raise the Beck Memorial Endowment numerous letters of encouragement and approval have been received from those best qualified to judge of the merits of this appeal.

"I do not need to remind you," states W. C. Arnold, M.D., director of medical services of the Department of Soldiers' Civil Re-Establishment at Ottawa, "of the very close relationship maintained since the war by this Department with all the larger sanatoria in Canada, nor of the fact that The Queen Alexandra Sanatorium has treated a greater number of our patients than has any other institution in the Dominion. It may therefore be opportune for me to state that the Department looks back on the work of your sanatorium with unmixed pleasure, feeling not only that the results attained have been excellent in every particular, but in addition that you and your staff have been unceasing in your efforts to break new ground wherever possible, and to keep your treatment up to the highest standard."

The allusion to the work of the Queen Alexandra Sanatorium in medical research, and in the preventive war carried on against tuberculosis in every part of Ontario has an echo in the letter of Dr. R. E. Wodehouse of the Canadian Tuberculosis Association,

"You have one of the best sanatoria in Canada" says Dr. Wodehouse, who is an officer of the Federal Department of Public Health," and you have probably done more practical research work than any other institution in Canada, in re-

gard to tuberculosis in recent years. It is very fitting that the people should respond to this worthy memorial to the late Sir Adam Beck."

Medical ethics forbid more detailed allusion to the research work of the sanatorium though public interest in such scientific endeavor has become so vital since Dr. Banting's discovery of the insulin treatment for the diabetes. Yet those who knew Sir Adam Beck have confidence that his comprehensive plan spreads far beyond remedial treatment or even preventive work. The Beck Memorial Endowment will serve in part to swell the small stream of dollars that has gone into the research laboratories of the sanatorium, upon which the eyes of the medical profession are already turned.

Mr. Magrath's announcement of his acceptance of the chairmanship of the provincial committee of the endowment campaign summarizes the considerations which impelled him to undertake this work. He said:

"I have accepted the chairmanship of the provincial committee of the Beck Memorial Endowment for the Queen Alexandra Sanatorium, because I believe we can honor the memory of the late Sir Adam Beck in no more appropriate way than by insuring the perpetuation and widest usefulness of that institution which he and Lady Beck founded, and to which they gave so much of time, money and self-sacrificing devotion.

"During his last illness he repeatedly urged that an endowment be raised to provide additional income which would help to bridge the difference between the amount patients cared for were able to pay and the actual cost of maintenance. Shortly before his death Sir Adam gave the initial $10,000 to start this fund. On the basis of the present capacity and work of the sanatorium this difference amounts to from $25,000 to $35,000 annually.

"It is due to the wise leadership of Sir Adam who was the sanatorium's president from its foundation

Preventorium Schoolroom.

to the time of his death, that this institution has grown into a place where medical experts in the treatment and prevention of tuberculosis proclaim it one of the finest, most ideally situated and best equipped institutions of its kind on the American continent. Its great service of health and healing, its leadership in preventive work, its efforts in modern research and training, in the treatment and care of tuberculosis, are felt throughout the entire province which it serves. At the present time there are 296 patients at the sanatorium. Every section of the province is represented in the list of those who are being helped back to health. The city of Toronto is represented by 52, London by 57, and 187 are from widely scattered sections. Because therefore of the province-wide service of this institution the opportunity will be given to all sections to contribute to this fund during the campaign.

"Sir Adam Beck can no longer lead forward this work. He has thrown the torch to us. In carrying it the people of this province will not only honor his memory, but will give the light of hope, health and healing to thousands who suffer with this dread disease, and will carry forward the war to stamp out tuberculosis.

"Our committee will ask that those who lead in the business and professional life of the various municipalities throughout the province join hands with us in a concerted effort to raise this memorial endowment fund during the period of November 20 to November 28."

Relay Practice and Operating Troubles on Transmission Lines.

By D. A. McKenzie, Assistant Engineer, Operating Dept., H.E.P.C. of Ont.

(Paper read before Toronto Section, A.I.E.E. Feb. 13. 1925.)

IT is not within the scope of this paper to go into the matter of the design of relay protective schemes, but it is the intention to discuss some of the schemes and devices which have been in service together with the troubles which were experienced with them.

It is hoped that the brief outline to be given will provide a basis for considerable discussion and that we shall have the benefit of the experience of many others.

It is comparatively easy to specify what is required of a relay protective scheme but reference to the technical press will disclose the unanimous opinion among the members of the profession, that the problems in connection therewith have not been solved. A rather considerable part of the A.I.E.E. meeting at Lake Placid in June 1919 was taken up in the discussion of Transmission Line Protection and several large and energetic committees have been working on the problem since that time, gathering data regarding the present practices of most of the important operating companies, and the success they are having with the equipment in use. It is expected, that the data thus obtained will be supplied to the profession at large—in the shape of the "Relay Handbook"—which has been promised for delivery shortly. It remains to be seen whether it has been possible to find a sufficient number of points of agreement in the practices of the various companies investigated, to enable them to formulate definite rules for even the simpler transmission systems. While it is quite evident that the matter of applying relay protection—or in other words—giving the best possible service to the consumer—should be considered in the design of the transmission system, it frequently happens that the transmission system has already been built, and it is now the problem to give as good service from it as possible and the most suitable of the comparatively few protective devices must be applied in the manner to do the most good. Their inherent limitations are generally recognized—but must be accepted—for the same reason that the system of lines is accepted—there is nothing else available. Moreover it would appear that the demand for electric service is increasing so quickly, that the necessity for even larger power plants, interconnection between systems, multiplicity of feeders, etc.—in an effort to make the best use of whatever diversity there may be between loads, is advancing the problem of relay protection faster than the developments in that art can

follow. Some devices—such as differential protection—have been applied to the station equipment—generators—transformers and buses—in order to remove these definitely from requiring consideration when dealing with the line protection. These have helped somewhat in simplifying this problem, and where economically possible, the idea is being extended to the lines themselves.

A brief discussion of the standard equipment available for use in the various protective schemes will possibly indicate the difficulties the operating man is likely to experience after the designing engineer has applied the available standard equipment to the line layout which is probably the result of extension after extension to meet the demands for a supply of power, and which was also quite probably built without having any attention paid to the matter of protecting it.

The first type of protection on circuits, was undoubtedly some type of fuse, and it is frequently necessary, or at least desirable—to make use of this device even now. While this device—at first sight—appears as simple as it is possible to conceive there still remains the difficulty that the characteristic operating curve or even the same type of fuse—does not remain the same for different current capacities—nor for the different voltage ranges. Add to this, the fact that each of the several different manufacturers use different fusible elements and apply them differently, and it will be seen that it is next to impossible to expect to obtain proper selective action where even these simple devices are used, unless a very considerable operating margin between fuses in series is permissible. Considerable research work in this matter is justified and if consistently similar characteristic curves may be secured between the various current and voltage ratings of any particular type, it would undoubtedly be advisable to use that type exclusively on any one system—regardless of cost.

As demands for service become more important—oil breakers are used for circuit protection. These devices were given—originally—the same function as the fuses—to open the circuit when an excess current flowed. This was accomplished by means of a solenoid placed directly in the circuit, with the plunger of this solenoid arranged to operate a toggle in the breaker mechanism and thus open it—or to close a contact whereby an auxiliary source of power would trip the breaker. For the lower voltages—this solenoid was generally mounted directly in the breaker tank, while for the higher voltages the solenoid is mounted on suitable insulation and transmits its motion by means of a long insulating cord or rod. This scheme has even been applied to horn gap air break switches. It will be evident at once however, that this scheme has a very serious drawback in that it is very difficult to make certain that it is actually in an operating condition, and if so, the value at which it will operate can not be very definitely known or adjusted. Where applied in single circuit lines—there is no source of power available when the apparatus is made dead for inspection and adjustment and without having

been tested by the actual passing of current through it, it is quite possible that some increase in friction or the fact that some part is out of alignment may render the entire device inoperative.

The next step forward is probably the use of a current transformer in the line—supplying an insulated trip coil which operates the toggle mechanism of the switch. These had also the objection that they could hardly be satisfactorily tested—though a considerable amount of intervening mechanical apparatus was eliminated and the probability of operation was greatly increased. In an effort to limit or fix the operating characteristic of this device—fuses were later used to shunt the trip coil. In those days, fuses represented the most reliable and satisfactory means for limiting the amounts of current. This was quite satisfactory for the systems then in use but as these increased in magnitude, it was found that proper selective operation was not obtainable and that more denfiite information was required regarding operating times.

A further device—or relay—was then interposed between the current transformer and the operating or trip coil on the breaker. The first function of these relays was of course to fulfill the same functions as had been previously carried out by the trip coils—that is, to take care of overload conditions—but now many other functions are performed. While the first of these overload relays were instantaneous in operation it was quickly found that it would be desirable to introduce elements in them which would control the speed of operation and thus the time limit device was applied. The first relays were, of course, of the simplest and most rugged type, the familiar solenoid. Time limits were introduced by opposing the operation of this plunger by different devices; on this continent the favorite device being a leather bellows with an adjustable air vent. In its simplest form, it will readily be seen that this device would have an inverse time characteristic. The greater the force the shorter the time—which was still very similar to the characteristic curve of the old fuse. This was satisfactory until with larger amounts of power, one got far enough out on the curve so that the time was so short as to be practically instantaneous and with several relays in tandem it was impossible to get proper sequence of operation. A definite time element was then desired on some of the relays and this was obtained by having the solenoid plunger act against a spring—which it would compress and which would require a certain—fairly constant time to compress the bellows. Later it was considered that it would be desirable to combine both of these ideas and obtain a relay which would operate in gradually decreasing times with increasing current—down to a certain time limit—beyond which the time element remains constant. This characteristic was obtained by the use of a small saturating iron core reactor in parallel with the coil of the relay. Not many of these were produced, as the necessity for greater accuracy in the time elements eliminated the old bellows elements, and a small repulsion motor type of relay

appeared—which had a fairly constant speed above certain currents. This motor carried its contacting device over various distances of travel to produce the different minimum time limits. This type has also been superseded by a much higher grade of relay—which approaches the switchboard instrument in refinement and accuracy—the induction relay which is the present standard.

It would appear that there is little probability of any further development in this line, as these can be relied upon to operate in a fairly definite number of cycles and is generally speaking—a quite rugged instrument, remaining in adjustment for satisfactory periods. Also the tendency, with the constantly increasing maze of interconnections and magnitudes of power, is to use some other function of the faulty circuit to determine whether the section shall be disconnected or not. It will be obvious that when several sections are in series, the excess current to any fault must traverse all intervening sections between the fault and the source of power. If these sections were sufficiently long that the impedance of the circuit could be relied upon to sufficiently reduce the available short circuit current, it might be possible to grade these excess current relays by means of their operating current values, to give selective action, but this would require circuits with excessive regulation in service, and with varying generator capacity in service and different types of faults to be considered, it is not feasible to do this. Grading them by means of the definite minimum time elements is feasible—though not always satisfactory—where only a few sections are in series. When sufficient margin between operating times is allowed to permit of breakers opening and clearing the circuit (at least 1-3 second, and generally ½ second) it will be seen that the operating time of the breakers nearest the source of power soon becomes excessive, and with faults in those sections the amounts of damage will become enormous. In fact, more than one engineer has advanced the requirement that as the fault becomes closer to the source of power, so should the period of time that it is permitted to exist become shorter. The relay engineers have therefore combined with this excess current relay,—a device which is intended to limit its field of action to the line section in which it is connected. This is done by means of a voltage element which prevents the relay from operating unless the system voltage drops by an amount which would correspond to a fault within the distance from this relay for which it is adjusted. Faults at a greater distance would not lower the voltage at this point sufficiently to permit of its operation. These relays are known as distance or impedance relays. They have only been available for general use for a short time and reliable information regarding performance under operating conditions is not available. The idea being novel and the field of application being not properly understood, it is believed that attempts have been made to use these devices in many places which did not carry all of the necessary factors. This

may account for some of the reports regarding unsatisfactory operation. The principle is so valuable however, that there is no doubt but that the idea will be developed, or settings adjusted, until satisfactory operation is secured from the equipment.

This idea of rendering the relay equipment on a certain section entirely inoperative during trouble in other sections has led to the development of other types of relays, the first of these being the reverse current or reverse power relay—later called directional relays. The first form of this relay—using the simple solenoid—with both a current coil and a voltage coil in the solenoid—with their fluxes in the same direction when the current was flowing in the direction it was desired to have the breaker trip and in opposition with the current reversed—was not used very widely—and the same may be said of the first of the induction types. These both had the property that even with current flowing in the normal direction, they would operate if the amount of current was great enough to overpower the effect of the normal line voltage, and with growing plants, the quantity of current soon became ample. A dynamometer wattmeter type was then developed—but having inherent shortcomings such as requiring appreciable voltages, etc., it has also been practically abandoned. The induction type of wattmeter has been developed to make a fairly satisfactory directional relay—operative with very low values of current and power factor. Some of these include within them excess current relays—which have inverse definite time limit operating characteristic—while another manufacturing company insists that all three elements for any line should be operative on a single shaft, since during fault conditions it is quite possible to have the current in certain phases of the circuit flowing away from the fault—but the combined effect of the power indications on all three phases might reasonably be expected to indicate towards the fault. However, even this is not always true with heavily loaded lines—and conditions whereby the fault current may be limited. In the use of these relays, considerable care is taken to choose potentials which may be as much undisturbed as possible by the fault current, in order to have conditions as favorable as possible for operation. Moreover, some companies go to considerable expense in the installation of separate transformers for each phase, in order to eliminate the possibility of wrong or faulty operation of the relays due to incorrect potential being supplied to them.

Still considering each circuit section as being protected individually—some companies have found it necessary on their most important circuits at least—to go to the expense of differential protective schemes. The simplest of these involves the use of instantaneous overload relays of the solenoid type, which are connected in the secondary circuits of current transformers located at each end of the circuit to be protected. Pilot wires are necessary for the full length of the circuit to interconnect the current transformers and this makes this scheme very expensive. One attempt was originally made to

protect the 110 kv. lines of the Hydro Electric Power Commission in this way, but after a few faulty operations the scheme was discontinued, before the reasons for failure were definitely ascertained. Where the expense of the pilot wires can be justified by the importance of the circuit to be protected, it is believed that this scheme will be found very satisfactory. It provides instantaneous operation in the event of a fault—thus acting before excessive current values are likely to be reached and reducing the strain on breakers—amount of damage done, etc., and is entirely inoperative in trouble in adjacent external circuits.

A somewhat similar protection is obtained by some companies by what is known as the split conductor principle. This scheme is also quite expensive but one operating company had adopted it very extensively. It is generally used on underground cable and, as its name implies—consists of two conductors per phase. These two conductors have only a very light insulation between them throughout their length but have regular phase insulation between their combination and the two adjacent phase combinations. Unbalancing reactors are used in these splits at each end to provide for operations with fault conditions near each end of the circuit and very sensitive instantaneous relays are used. This scheme might more properly be called balanced protection rather than differential.

The use of two or more similar line sections in parallel permits of various schemes of balancing between the circuits being used. The simple solenoid or plunger type of relay is used and instantaneous operation is secured. These schemes have also the great virtue of not requiring the introduction of potential which results in more reliable operation and in more rugged equipment and the elimination of considerable auxiliary equipment. Very successful operation has been secured from many applications of this scheme—but some instances of failure are on record—these resulting from the fact that certain conditions necessary to their successful application are not fulfilled. Some additional development work on the various relays available for this class of protection—would also appear desirable—for instance—one company had developed the instrument type—or induction principle to this type of protection obtaining many desirable features—but they have neglected to bring out separate leads for the trip circuits—thus limiting its application and interfering with its general value.

Auxiliary relays to give definite time limits have been built on several different principles—viz., solenoids—operating through a spring against a bellows—similar to the primary definite time limit relay, weights operating against special air or liquid dash-pots, and clock work mechanisms—or gear driven fans. These are still used in a few special cases, but generally speaking, it may be considered that these have been abandoned.

Having considered the equipment available for determining that the breaker should be opened, the next step is to consider the auxiliary breaker should be opened, the next

equipment required to actually open the breaker, since only in some of the original series relays was there provided sufficient power to actually operate the release on the breaker. In the latest—most highly developed relay devices—sufficient power is available only to close a fairly delicate contact. An external source of power is then provided for the operation of the breaker. The most reliable source, so far, is the standard lead storage battery of sufficient capacity. To use this, trip coils are placed on the breaker, which are energized either by means of the contacts of the relay or by means of an auxiliary relay which has been actuated by the primary relay. Even for the larger breakers the actual power used to trip the breaker is not great, being in the order of 200 watts to 2,000 watts for the latest 110 kv. breakers.

In many cases, however, the standard 125 volt storage battery is not available—as it represents too high an operating and maintenance cost in comparison with the total cost of the station. The matter of obtaining a satisfactory and absolutely reliable source of power then admits of two solutions—first the use of energy directly from the circuit affected—and the provision of a cheaply replenished separate source of power. The first is by far the most desirable if it can be satisfactorily utilized, since the necessity for the operation is only apparent when the power in the circuit is available. Several methods have been developed for using the power from the circuit—through the medium of the secondary current from the current transformers, to operate the trip coils of the breakers. The first was mentioned previously in the most simple type of excess current protection. However, when the relays were used, the problem was complicated somewhat, though, it appeared a comparatively simple matter to equip the relays with contacts which were normally closed and to bridge the trip coil across these contacts. When the relay operated and opened the contacts—the current from the current transformer passed through the trip coil and released the oil breaker. This device requires very good contacts—with an appreciable contact pressure. Moreover, with the comparatively high inductance of the trip coil and the large currents available from the current transformer—these contacts become badly burned and no longer shunt out trip coil when the relay is not in operating position. The original type of contacts for this service consisted of a section of a cone resting in between three contacts. Due to the trouble with this device burning, it was abandoned and one company now uses a plain silver butt contact held closed by a simple phosphor br nze spring—which is perhaps the most satisfactory device developed, though these contacts still require frequent inspection and dressing. Another company developed a spring closed butt contact also—but introduced a sort of toggle mechanism to give it a quick wide break. This undoubtedly reduced the fouling of the contact surfaces but as the current had to be carried through the various members of this toggle device, it was found that a great deal of burning

occurred at the joints between these members. Another company developed a carbon break contact and later brought out a silver butt contact opening under oil—which appeared to have considerable merit. It would be very desirable, if this idea could be further developed, as there is a great field of application for this source of power in the smaller stations. In this connection it might be mentioned that one manufacturing company has made a practice of equipping their manually operated oil breakers with one trip coil only and it will be evident that, with the two or three relays which must be used to protect the standard three phase line, it is impossible to use this single trip coil in such a way that one is assured of its proper operation under all conditions of fault current. Certain changes of connections have been used which have greatly reduced the strain on the insulation, etc., of the current transformers and have improved the probability of proper operation. A second trip coil should always be supplied. While three trip coils are necessary where three relays are used, it is believed that two relays supplied from Z connected current transformers will give sufficiently reliable protection and three relays are therefore not necessary even on three phase four wire systems.

In view of the amount of power available from the current transformers and the reliability of it, a very ingenious attempt was made to utilize it with circuit closing relays which obviously escape the contact troubles of the circuit opening relays. This consisted in installing current transformers on the main bus—in such a way that all current supplied was required to pass through them. These transformers then supplied a potential or tripping bus—which had a reactor permanently connected across it to provide a path for the secondary current so that these current transformers would not be operating under open circuit conditions. This idea apparently has considerable merit and while reliable operation was not secured in several installations of this scheme, this failure to operate properly could readily be accounted for by the apparent weaknesses of the equipment used in the application of the scheme. For instance, one application involved the use of very light tripping plungers—auxiliary definite time limit relays—supplied from this tripping bus and an excess current relay which had very poor resetting qualities. In other applications the same current transformers were expected to operate the overload relays as well as supply the tripping bus potential.

Two types of auxiliary or "transfer" relays have also been developed which permit of the use of circuit closing relays of the latest and most accurate type and which normally shunt the trip coil of the breaker. These have quite an appreciable impedance and add materially to the secondary burden of the current transformers but this is not always very objectionable. The latest or privately developed of these relays is very simple and rugged and gives good promise of satisfactory operation. No operating experience has been had with the first of these

devices—but the mechanism appears so complicated that it would be expected that trouble would soon develop in them.

Special trip coils have also been built for tripping from the current transformers—which have holding coils mounted on the same spindle. The circuit closing relay neutralizes this holding coil and the trip coil operates the breaker. Fairly satisfactory operation has been obtained from this simple equipment—though a few coils have been destroyed—probably due to large currents available. This equipment also undoubtedly adds materially to the burden of the current transformers.

In some cases it is not feasible to drain energy from the line by means of current transformers—for example where series relays are used,—and a convenient source of power must then be found. It was quite natural that the low voltage storage battery be considered and fairly wide use was made of them. However, the maintenance cost of the storage battery proved to be very high, and the standard dry cell was next considered. It has proved much cheaper in up-keep and maintenance than the storage battery and requires less skilled attention. Even with the dry cell batteries it is found that the replacements will average from 60 to 75 per cent of the total capacity per year so that this is a comparatively expensive source of power. The use of d.c. from either source is, however, subject to two operating draw-backs—first—frequent operations, or the sticking of a contact may discharge the cells to such an extent that they no longer have the necessary capacity to trip a breaker and, secondly—in this climate, it is quite common for the temperature in the small unattended stations to get so low that neither type of cell will function. Moreover, it is found that the contact resistance of many types of relays is so great that uncertain results are obtained from the standard 12 volt source and 24 volts is now being recommended by the manufacturers. This, of course, will practically double the maintenance costs which are already high.

An occasional installation has been made in which the tripping bus has been supplied from the 110 volt a.c. service or from potential transformer secondaries. This is a very unreliable source of power, as during trouble, the a.c. voltage is very likely to be reduced to such a low value that it is not sufficient to operate the breakers.

Summarizing, it will be seen that with the latest type of excess current relay—which is used for at least 80 per cent of the total transmission line protection—very reliable operation can be expected. The directional relays, which will probably embody 10 per cent of the total—are not yet very reliable—due to the necessity of utilizing voltages—which, in spite of every care—may be so distorted in value and phase position as to render the devices inoperative or to cause them to operate wrongly. The contact mechanism on these directional elements are also so delicately adjusted as to be responsible for many faulty operations. Additional mechanical refinements are desirable on the balanced relays, the plunger type being unstable mechan-

ically and the induction type requiring different arrangement of tripping circuits, etc. Other types of relays are not in general use in sufficient quantities to enable a satisfactory opinion as to their inherent weaknesses to be formed. In addition to the relay troubles there are many cases of mechanical trouble in the breakers—and auxiliary equipment—faulty contacts in pallet switches and auxiliary relays—failure of tripping supply, etc.

Having considered briefly the inherent limitations of the devices available, it will be seen that—even on systems where the simple excess current devices only are used, it will be difficult to obtain proper selective operation of the breakers to segregate trouble to the section actually involved. The original intention in the setting of these devices was evidently to have them arranged to carry safely any expected normal load current but to operate when this normal load current was exceeded by a certain percentage. No attention was paid to the fact that the fault current on any particular station would be practically the same for all feeders, regardless of the load normally carried on them. This is being taken into account more and more but, due to the fact that the current transformers in any feeder, are generally chosen with some reference to the loads carried on it, the condition still exists to a certain extent. However, in many stations it has been found necessary—to avoid the cost of special low ratio current transformers of high mechanical and thermal capacity—to specify certain minimum ratios of standard current transformers.

In many cases there are special considerations relative to the rupturing capacity of circuit breakers, mechanical stress on apparatus, etc.—which limit or determine the system operating conditions to such an extent that certain types of relay equipment which might be comparatively rugged and simple—can not be employed. This has particular reference to the matter of grounding the neutral of the transmission system.

With the comparatively large excess current settings now being used, one can be reasonably certain that there will, in general, be a very good reason for the opening of any particular breaker and the frequently given report—of "Unlocated Cause"—is not so willingly accepted. However, we still have it in a great many more cases than would appear reasonable. Of course, breakers have been known to fall open, but it is occasionally suspected that there is a strong tendency on the part of an operator to cover up his mistakes by blaming the relay equipment. The use of operation indicators on these devices, however, will tend to assist the operator in locating the trouble causing the operation of the breaker and will provide a further check on his reports in the case he attempts to escape the results of incorrect operation.

The importance of frequent inspection and careful setting of the relay devices is apparent, especially so when it is realized that with different types of loads used in the setting of relays, it is possible to obtain materi-

ally different operating times with the same currents. Also, when the current transformers are operating at the overloads possible on many of the large systems, there is the doubt as to their operating characteristics. With the standard current transformer operating with, say, a secondary burden of one ohm., its output at full load is 25 voltamperes. At ten times rated current—a value which may be exceeded in many stations, this output would tend to be 2500 voltamperes—which is obviously doubtful. Investigation is being made into the normal secondary burden on these devices and the probable behaviour of the standard current transformer on secondary burdens up to at least one ohm.

Accurate and detailed reports are obtained of every relay operation on most systems and any operation which has even a slight doubt as to its reasonableness, is immediately investigated. These reports are carefully studied and any desirable changes in the adjustments of the relays at various points on the system are quickly noted. These last two remarks apply not only to too frequent operations—but also to failures to operate, when they might be expected to. It frequently happens that this study reveals the unsuitability of certain types of relays at certain points of the system and it is evident that even with the best of care in adjustment and maintenance, it is not possible to greatly reduce the number of faulty operations. It has also, in some cases, indicated errors in the matter of potential supply to directional relays, etc. Many of these shortcomings must be endured even though they are evidently responsible for practically all of the faulty operations of the breakers. It is a matter of considerable satisfaction to know that for one year on one high voltage transmission system, 70 percent of the total operations were correct even in spite of the use of equipment of known unsuitability while on lower voltage transmission systems—96 and 90 per cent of the total operations were justified. It is believed that with the replacement of certain types of relays, even these latter high percentages may be raised. It should be readily apparent that, even with the most careful adjustment and frequent inspection, it will be impossible to obtain satisfactory selective operation—which is necessary if the minimum number of people are to be inconvenienced by any case of trouble—unless all equipment in the series is properly selected for its duty. The use of the less reliable types in locations nearest the source of power will render useless the application of high grade equipment further along the line.

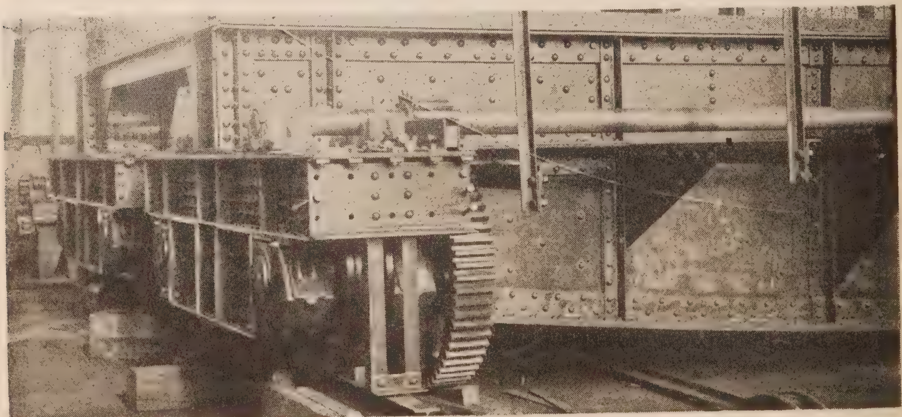
Since most companies find it difficult to maintain construction programs which will keep pace with the expansion of the business and since there is a strong tendency to retain equipment in service so long as it is operative, it will be found that much equipment with known shortcomings is still in service on all systems—and interfering with the excellence of the service which might be obtained from equipment on later installations. It is admitted that it is hardly practicable to wipe out entirely a complete installation of equipment, the moment that a more

suitable type of equipment is available, but this is frequently necessary if a satisfactory standard of service is to be maintained. The value of this equipment from a protective standpoint must also be considered—aside from the matter of giving service. Since this is in the nature of insurance on considerable amounts of expensive apparatus, it is only reasonable to obtain the best insurance possible and to abandon any scheme which is apparently inferior. The damage done during one case of failure to operate properly may result in the loss of equipment of hundreds of times the value of adequate protective devices.

Features of the Crane Service, Queenston Generating Station

By Harry E. Brandon, Electrical Engineering Dept. H.E.P.C. of Ont.

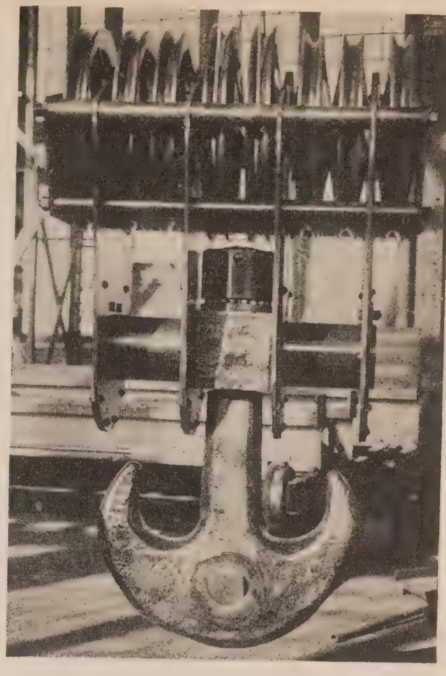
THE crane equipment for the Generator Room of the Queenston Generating Station is of particular interest when the heavy maximum loadings and the nature and variety of the service is considered, these cranes being occasionally required to lift the 300 ton generator rotors from their assembly bases and to lower them into position, governing the movements of the rotors to within a small fraction of an inch, and in addition being frequently required to handle a great variety of smaller loads.



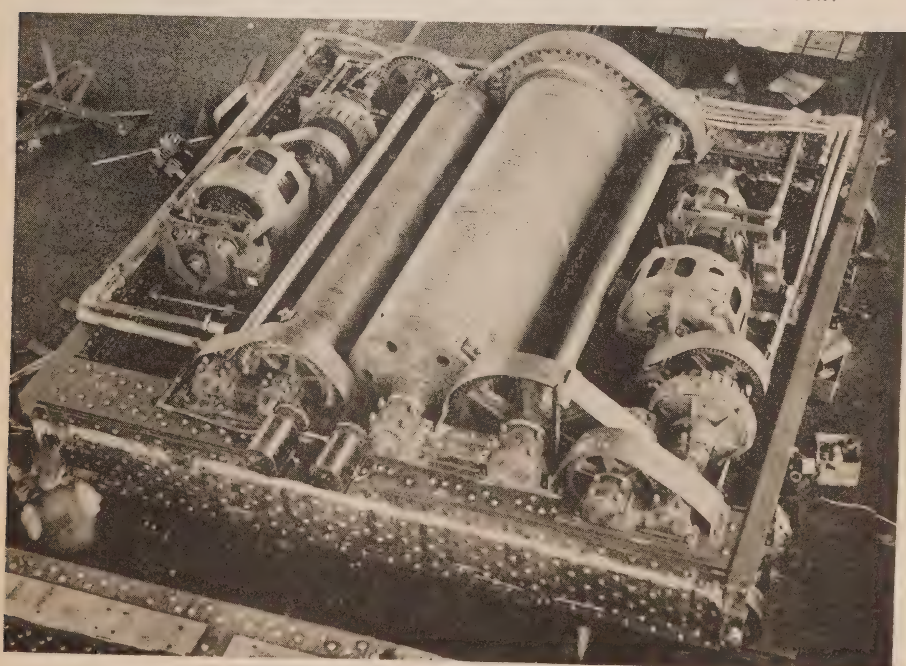
View showing Structural Features of Bridge and End Carriage.

The equipment purchased from the Dominion Bridge Company to perform all services consisted of two electrically operated overhead travelling cranes, each with a rated capacity of 150 tons and each having an additional or auxiliary hook of 25 tons capacity. The addition of an equalizer beam hung by each end from the 150 ton hooks served to combine the lifting strength of the cranes to handle the 300 ton load, while with the beam laid aside the two independent cranes were available to supply the heavy demand for crane service during construction periods. The 25 ton hooks are used for lighter loads and their lifting speed is faster.

The equalizer beam is constructed largely of plates and angles, is of box type 27ft. 0 in. long, and weighs about 25 tons. At each end of the



150 Ton Block and Hook.



Plan view of Trolley.

beam, a large pin is provided bearing on a system of diaphrams, and passing through a hole in the crank hook. The load is connected to the centre of the beam by means of a large cast steel sleeve, the side pins of which pass through and make bearing contact with the reinforced webs

Assembly of 190 ton Test Load.

of the beam. In taking up the load the beam is first lowered so as to allow the rotor shaft to project through the sleeve, then a shear ring is clamped into a groove in the rotor shaft. On its upward movement the beam then picks up the load through the medium of the shear ring which bears on a ball bearing on the top of the sleeve. This ball bearing, which enables the 300 ton load to be turned while suspended, contains 40 steel balls 2½in. in diameter.

The 150 ton double hooks are 3ft.-4½in. out to out of points and 5ft.–11½in. from bottom of hook to centre line of sheaves. The load is lifted through the medium of 16 parts of 1–⅛in. flexible plow steel cable.

The trolleys and bridges of the cranes embody standard principles of crane design and are built largely of structural steel, the thoroughness of the design and the workmanship of which are worthy of note.

In order to assure that the cranes were in proper condition, and capable of lifting, lowering and carrying the 300 ton load, each crane was subjected to a test as provided in the contract, that is, each crane was tested under a load of 190 tons (or a load about 25% greater than the rated capacity) thus allowing for any additional stresses due to impact which might be brought to bear on the equipment.

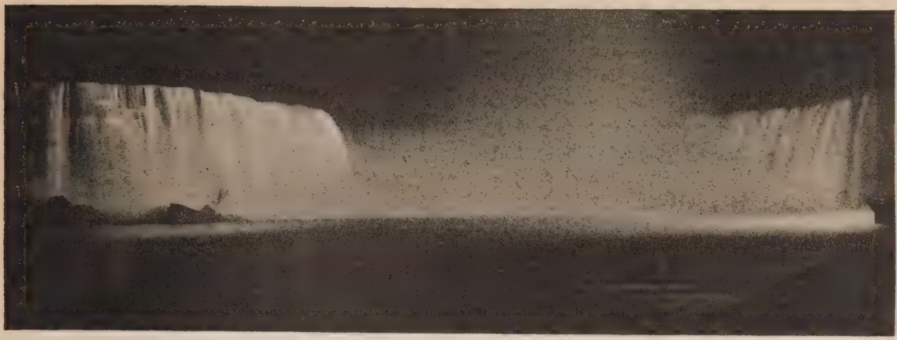
To perform this test three large transformer tanks were hung from the equalizer beam and filled with water to the required height to make up the weight. This load was raised, lowered, and carried by each of the cranes.

When using the two cranes in combination and with the equalizer beam attached, the crane bridges are coupled together to combine the driving strength of the two bridge motors in carrying the load throughout the length of the power house. Speeds of lifting, lowering, and cross travel are equalized by each crane operator taking signals from a rigging foreman stationed at a convenient point on the floor of the power house, or riding on the load.

The combined weight of the crane equipment is approximately 436,000 lbs.

Illumination of Niagara Falls

HIS first view of the cataracts was on Friday night, when he saw them as no man had ever seen them before, and as they will probably never be seen again—he saw the Falls of Niagara illuminated. At the first idea it seems about as feasible to light up the Atlantic as these great outpourings of Lake Erie; and Mr. Blackwell, when he started the idea was looked on as well-meaning and all that, but chimerical, to use the mildest term. Mr. Blackwell, however, persevered, and had some 200 Bengal lights made of the largest size which it was possible to manufacture. About twenty of these were placed in a row under the cliffs, beneath Clifton House, and facing the American Fall; twenty more were placed under Table Rock, and twenty more behind the sheet of water itself, the entrance to which from the Canadian side I have already described. At ten o'clock at night they were all lit, and their effect was something grand, magical, and brilliant beyond all power of words to portray. In an instant, the whole mass of water, glowing as if incandescent in the intense light, seemed turned to molten silver. From behind the fall the light shone with such vivid brilliancy that the waters immediately before it looked like a sheet of crystal glass, a cascade of diamonds, every head and stream in which leapt and sparkled and spread the glare over the whole scene, like a river of lighted phosphorus. The boiling rapids underneath dimly reflected back the vivid gleam as from a mirror, lighting up the trees and rocks and all the wild, torn chasm through which the rapids pour, and showing out the old grey ruins of Table Rock like a huge dilapidated tower. The smoke too, rose in thick, dense masses, spreading upwards over the cataracts in a luminous cloud that it seemed as if the Niagara was in a blaze from base to summit. But all the grandeur and beauty seemed as nothing to the effect produced when the lights were changed from white to red. Niagara seemed turned to blood in colour, but so bright, so lurid in its deep effulgence, that a river of seething, roaring, hellish fire



seemed to have taken the place in an instant of these cold, stern, eternal Falls. None could look upon this scene, the huge, fiery, blood-red mass dark-looking and clotted in the centre, without a feeling of awe. You could not speak, so sublime were its terrors, nor move your gaze from the blazing cauldron underneath the falls, where the river seemed in its frothy red foam like boiling blood."

Note: The above is an extract from the Illustrated London News of October 6, 1860, describing the illumination of the Falls on the occasion of the visit of the Prince of Wales in August of that year. We wonder whether the correspondent would have enthused equally at the sight of the present illumination (had he been permitted to view it.) Perhaps the descriptive powers and imaginative faculties of the modern newspaper writers were surpassed by those of his ancestors; or perhaps the illuminating engineers of that day with the limited means at their disposal, achieved the wonderful effects described, at any rate, we are sure the quotation will be of interest to readers of the Bulletin.

Meter Reading and Customer Billing.

THE electric meter is one of the most essential instruments utilized in the distribution of electrical energy. The revenue from an electrical utility is dependent upon the correct functioning of such an instrument, and the accuracy of the meter records is of such a vital character that it is impossible to emphasize or stress too strongly, the care which should be given to it by every member of the staff whose duties are in any manner connected with this branch of the service. The success of an electrical utility is just as dependent on accuracy and carefulness in both the reading and the recording of the reading of meters as is a business of a coal merchant or a grocery store upon the correctness of the scale over which all of the commodities handled must pass before going to the customer. Scales in use by all merchants engaged in doing business with the general public have been developed to a very high degree of accuracy and the legislation in force on the statute books in connection with such gives thorough protection to the customer. Similarly, the electric meter has also been developed into a most efficient instrument and the customer is also protected by legislation as to test and accuracy.

In most cases, the electric meter will perform its work satisfactorily and the difficulty encountered in billing a customer is usually the human element involved between the meter and the customer's bill. Various complications are encountered in meter reading, such as the use of constants, current transformers with varying ratios, and a large number of dials revolving in various directions, but on the correctness of the reading itself and the accuracy of the record, depends the very life of the business.

The meter reader in every case should form the habit of checking each reading mentally as he places the record in his meter book. When a new installation is being read for the first time, particular care should be taken to ascertain if the meter is direct reading or if a constant is employed to obtain a complete record. In the case of a power customer, the current transformer ratios should be accurately noted, as perhaps more errors in meter reading are due to improper records on account of such, than to all other causes put together. The consumption should be mentally checked with a figure considered to be the customer's average consumption and compared with previous readings. There is no doubt whatever but that the proper time to ascertain discrepancies is during the reading operation, as information is then obtainable which is absolutely lost or forgotten when at a later date trouble may ensue over a customer's complaint. All that is required is to exercise a little common sense and a short mental calculation, which with care, can be easily acquired by habit and should not consume an amount of time which would in any

way interfere with the average number of readings necessary to complete a regular day's work. If the meter reader is to be considered merely an automatic machine for the placing of so many figures in a meter book, and is not supposed to exercise ordinary human intelligence, then errors and mistakes will continue to occur beyond all possible remedy, but if the meter reader is carefully instructed and informed as to the importance of his work, there is no doubt but that he will be in a position to eliminate a large portion of the difficulties which arise from time to time over customers' complaints as to inaccuracy in meter readings.

A meter reader constantly engaged in reading meters should be able to judge by conditions and previous readings whether the reading of John Jones is normal or abnormal, and if the latter, very little effort will ascertain whether the trouble is due to an error in reading the meter or to some other cause about which he should collect any evidence which will at a later date assist in meeting the customer's complaint. This method, in most cases, will detect fast or slow meters, eliminate errors which might result from changes in meter installation when a constant is employed on the new installation and not on the old one, and from changes in current transformer ratios and the like, all of which are possible sources of trouble if not carefully watched.

Correct meter reading is, however, only one of the operations in billing customers which requires careful attention, and unless the card records are carefully kept and particular care given to the placing of all information concerning each and every meter upon the customer's card, all of the efforts of the meter reader to perform his part of the job correctly and efficiently may be of no avail. The matter of constants and current transformer ratios should be carefully watched by the billing clerk and the actual consumption of every consumer checked against previous readings to ascertain if the result is normal or abnormal. Meter readers and billing clerks should have some special training and they should acquire some knowledge with respect to the use of the different types of meters. It is most essential that they know the difference between a direct reading meter and one utilizing a constant, and they should be carefully instructed on these matters. They should be taught the importance of their work and firmly impressed with the essentials necessary in the proper performance of such, which may be briefly summed up as care and accuracy in the keeping of all records, the proper recording of all detail data concerning customers' meters, checking readings to ascertain the possibility of error and the exercising of the intelligence and common sense with which every ordinary human being is endowed.

On Exaggeration

Overstatement is a weapon often employed by propagandists. It startles the reader or the listener and fixes his thought upon a subject when possibly the truth and nothing but the truth told in moderation might leave him uninterested. "Stunts" on occasion justify themselves in the result, but the public tires of stunts, and once bitten becomes twice shy. Ordinary mortals clothe themselves in protective armouring, proof against exaggeration, and become critical and sceptical. Now, slogans are excellent in their way, and they serve their purpose for a time, but new ones should be ready to take their place before they are worn out. Electricity has had its slogans, and we could do with some arresting ones now, but they need not express exaggerated claims. Electricity is able to do so much and to do it all so well that exaggeration is quite unnecessary. The merits of electrical service—when it is given proper trial—are self-demonstrative. The purpose of the slogan or the propaganda claim is to impress the minds of those who do not *know*, but who need to be brought to fixity of thought regarding electricity and compelled to interest themselves in it. Therefore, publicity must be efficiently employed, forcefully but fairly stating its merits. Some criticism may be offered of those who have advocated it as a panacea for all industrial ills at a time when hundreds and thousands of men have been earnestly searching for a way out of most serious situations. Its advocacy as the householder's way of solving domestic problems requires discretion too, because, say what we will, in large numbers of homes there is not money to spare for electrical installation and supply at present costs. Convenience is worth much to many, but it cannot be paid for by all. Even with the "All-in" rate of the Electric House, the bill is not small compared to previous bills for lighting and heating—it is in convenience and cleanliness and labour-saving that electricity scores, and these are things which must be paid for. The consumer who is led on to the mains under false impressions as to cost is not going to be a help in the long run—he may even be a hindrance if he spreads abroad an anti-electrical experience. Overstatement or optimism is a very pronounced weakness with some who have the drawing up of electrical company prospectuses, but Nemesis relentlessly dogs the steps of such, and extravagant promises have to be paid for by somebody. We have known extravagant statements to be issued to the Press by manufacturers' publicity departments—a most short sighted practice to adopt. Self-respecting editors do not admit such into their pages, and the unavoidable result may be an inclination so to deal with over-statements as to make them briefer than they would otherwise be. Another class of overstatement that occurs to the mind is excessive praise of men; if it be laid on with a trowel it often fails in its intention, for it raises a smile but is not treated seriously by listeners.

It does little harm, however, for most of us are wonderfully clever at discovering the depth of sincerity of such utterances.—*The Electrical Review.*

Requiem

SIR ADAM BECK

Draped, the wide portals, in purple,
Laurel and bay wreaths hung;
Emblems of sorrow and mourning,
'Neath the flag at half-mast flung.

These be the outward tokens,—
Signs of a nation's grief,
Marking the death of a hero,
The Hydro's stalwart chief.

Never more shall we hearken
To his ringing clarion calls,
Bidding the peoples rally
In defense of their water-falls.

Hushed is the voice of warning;
Closed are the eyes of the sage,
Who, heedless of passing decades,
Fought for our heritage.

But the stately towers go marching
O'er Ontario's hills and glens,
Bearing their precious burden,—
Nature's gift to her citizens.

Monuments, these, to his daring,
Proclaiming through every hour
Honour and praise to Sir Adam,
Champion of light and power!

Perish his name shall never,—
None shall his life-work wreck,
For the users of Hydro power
Ever honour the name of Beck!

Some hath he left behind him
To follow the trail he blazed;
Each year shall they grow in number,
Louder his name be praised;

Till every power be harnessed,
Serving a nation's need,—
Then shall Ontario's people
Honour his name indeed;

These sound a lasting pæan,—
Nought then his work shall wreck;
Every village and town and city
Shall acclaim SIR ADAM BECK!

B. E. Fletcher,
August, 1925.

HYDRO NEWS ITEMS

Central Ontario System

A number of rural districts outside the City of Peterborough have been up to the present, served at city rates, or near city rates, by the City of Peterborough. The Commission has prepared a valuation of all lines outside the City and has set rates at which the City can operate these lines at cost. This has been done at the request of the City of Peterborough who have found that these lines have been unprofitable in the past.

* * * *

The substation changes in the City of Oshawa have now been completed and the new 3000 kv-a. transformer was placed in service on September 6th.

* * * *

A number of rural lines around the City of Oshawa are now being combined to form one Oshawa R.P.D. and new rural rates will be set for same.

* * * *

The new circuit has been strung from Norwood substation to the Municipality of Havelock in order to improve the regulation in the town. This was necessitated by the installation of a large compressor by the C.P.R. at their roundhouse in Havelock.

* * * *

A number of changes will be made in the distribution system in the village of Orono to give better service to the consumers.

* * * *

St. Lawrence System

The Police Village of Embrun has requested estimates on cost of power and a distribution system. The requirements of this village would be supplied from an extension off the 4,000 volt line, under construction, from Chesterville to the Police Village of Russell.

* * * *

An extension has been completed and another extension is being constructed to supply rural residents in the Martintown Rural Power District.

* * * *

The Commission again, at the request of the Provincial Government, made a demonstration at the Ontario Plowmen's Association's Plowing Match at Brockville.

The demonstration was housed in two 20 x 40 tents. In No. 1 were set up appliances, stoves and utensils for use in the house. No. 2 tent was divided into two sections, representing the dairy and the barn. In the dairy section, a 4 foot length of line

shafting was driven by a one horse-power motor and to this was belted a cream separator, a pump and a churn. In the barn section, a 12 foot length of line shafting was driven by a three horse-power motor. To this was belted a root pulper, a chopper, a power washing machine and a cutting box. In addition to these, an automatic water system was mounted on a barrel which served the purpose of a well. The opening of the tap started the unit in motion and the closing of the tap stopped it. One visiting farmer's comment was that it was provided with brains in a box.

The attendance at the Match was estimated to be well over 30,000 and the engineers in attendance at the demonstration believed that at least one-half of those visiting the Match passed through the demonstration tents.

List of Electical Devices, Material and Fittings

Approved by the Hydro-Electric Power Commission of Ontario in September, 1925.

Appliances

Duffie Electric Manufacturing Co., Limited, 1303 Queen St. W., Toronto, Ont.

"Tropical" Electric Cooker, Cat. No. 6.

* * * *

Findlay Bros. Co. Limited, Carleton Place, Ont.

Hotplates, one and two burner, stationary type. Cat. Nos. E1 and E2.

Hotplates, one burner, portable type, Cat. No. E0.

* * * *

The Fitzgerald Manufacturing Company, Torrington, Conn.

Air Heaters, "Star-Rite". Model C.

* * * *

National Electric Appliance Company, 8301 Madison Ave., Cleveland, O.

Electric Curling Iron, "Princess".

* * * *

The Premier Vacuum Cleaner Co. Limited, 233 Richmond St. W., Toronto.

Vacuum Cleaners, "Magic", "Empire", "Dominion".

* * * *

Russell Electric Company, 340 West Huron St., Chicago, Ill.

"Hold-Heeter" Portable Electric Air Heater.

* * * *

Standard Radio Manufacturing Corp., 90 Chestnut St., Toronto, Ont.

Radio Appliances "A" and "B" battery eliminators.

* * * *

Sterling Actions & Keys Limited, 24 Noble St., Toronto.

Electrically-operated Pianos.

* * * *

Southern Electric Company, 107 Richmond St., E., Toronto.

Electric Coffee Percolators "Southern Electric Co."

* * * *

Whittaker Fireplaces, Windsor, Ont.

Mantel Grate, Cat. No. 74A.

Electric Air Heater, wall type, Cat. No. 47.

* * * *

*Christian Electric Co., 15 Ferry St., Windsor, Ont.

Electric Water Heater, Type A.

* * * *

Switches

Benjamin Electric Mfg. Co. of Canada, Limited, 11-17 Charlotte St., Toronto.

Porcelain Cutout Bases. Cat. Nos. 59904, 59908, 59912.

* * * *

*Harrington - Seaberg Corp.' (Mfr.) 1708 Third Ave., Moline, Ill.

Magnetic Sign Flasher Corp. (Submittor) Davenport, Iowa.

Sign Flasher, Type D-3A.

* * * *

Fittings

Benjamin Electric Mfg. Co. of Canada, Ltd., 11-17 Charlotte St., Toronto.

Receptacles for Attachment Plugs, Cat. Nos. 7651 and 7654.

Brass Plates, Cat. Nos. 7652, 7655.

Fuseless Attachment Plugs, Cat. No. 916.

Current Taps, Cat. Nos. 77, 122, 1042, 808, "Furnitap" Cat. No. 7696.

* * * *

Duncan Electrical Company, Limited, 2 Inspector St., Montreal, Que.

Medium Base Receptacles, brass shell, porcelain base, Cat. No. 9184; all porcelain, Cat. Nos. 11034, 11037. "D.E.Co." or "D".

Medium Base Sockets, brass shell, Cat. Nos. 660, 662; porcelain shell Cat. Nos. 11025, 11028, 11031.

* * * *

J. R. Ferguson, Galt, Ont.

Cast-iron Outlet Plate with bar.

* * * *

The Hessco Electric Manufacturing Co., 65 Frederick St., Toronto.

Medium base sockets, Cat. No. 301C.

* * * *

Ren Manufacturing Co., Lyceum Bldg., Winchester, Mass.

"Ren-Lock" socket locking device.

* * * *

*Arrow Electric Co., Hartford, Conn.

Fuseless Attachment Plugs (as listed on Underwriters' Laboratories card dated June 26, 1925).

* * * *

*Atlas Metal Products Co., 3739-45 Beubein St., Detroit, Mich.

Outlet Boxes and Plates. Marking: M-C Atlas, Detroit.

* * * *

*Best Electric Corp., 476 Broadway, New York, N.Y.

Medium Base Sockets, Cat. Nos. 850, 1010. Marking: "Best" on shell.

* * * *

*Oliver Electric & Mfg. Co., 4221-27 Forest Park Blvd., St. Louis, Mo.

Cast-iron Conduit Boxes. Types SCB, SCBF. "Oliver".

* * * *

*Pass & Seymour Inc., Solvay, N.Y.

Medium Base Receptacles (as listed on Underwriters' Laboratories card dated July 14, 1925).

* * * *

Lighting Devices

Canadian Kodak Co. Limited, Mount Dennis, Ont.

Portable Electric Lamps. "Eastman Kodak Co".

* * * *

United States Glass Co., 9th and Bingham Sts., Pittsburgh, Pa.

Portable Electric Lamps, "U.S.G. Co."

* * * *

Miscellaneous

Dominion Machine & Tool Co. Limited, 77-79 Peter St., Toronto.

Loom Clips. "D".

* * * *

*These devices are under the Underwriters' Laboratories Label or Re-examination Service.

Re. Municipal Populations

To enable The Bulletin to give as nearly as possible the correct populations of the Hydro Municipalities as shown in the lists on the inside of the cover, it would be of considerable assistance if the Municipal Officials advise of any corrections that should be made.

—Editor.

THE BULLETIN

Published by
HYDRO-ELECTRIC POWER COMMISSION
of Ontario

190 University Avenue
Toronto

Subscription Price $2.00
Per Year

Welcoming Banquet to Mr. Magrath

A very striking public tribute to Mr. Charles A. Magrath, the new Chairman of the Hydro-Electric Power Commission of Ontario, was paid by nearly 700 engineers and business men by a banquet tendered Mr. Magrath at the King Edward Hotel, Toronto, on the evening of the 18th of November. The engineering organizations which cooperated to give this dinner were: The Engineering Society, University of Toronto, the Ontario Land Surveyors' Association, the Engineering Institute of Canada, the Canadian Institute of Mining and Metallurgy, the Engineers Club of Toronto, the American Institute of Electrical Engineers (Toronto Section), the American Society of Mechanical Engineers (Ontario Section), the Canadian Institute of Chemistry and the Association of Professional Engineers of Ontario. In addition, there were representatives from practically every sphere of Ontario's professional, industrial and commercial life. There were many representatives from outside the Province, while the Province itself was represented by Premier Ferguson and other members of his cabinet. It was, as the Chairman of the Banquet, Professor H. E. T. Haultain, Dean of the Faculty of Mining of the University of Toronto, said, a "tribal shout" of honor to a member of the engineering profession upon the bestowment on him of the additional distinction of being appointed to the Chairmanship of the Hydro-Electric Power Commission of Ontario.

The toast to the professions was proposed by Dr. Arthur Surveyer, of Montreal, President of the Engineering Institute of Canada. Mr. Surveyer dealt with the important functions of the various professions and explained the great service rendered by the engineering profession. In the name of the engineers of Canada he congratulated Mr. Magrath on his appointment to the responsible position he now

CONTENTS

Vol. XII. No. 11

NOVEMBER, 1925

occupies. Mr. Surveyer referred to the public record of Mr. Magrath and expressed the deep interest all members of the profession would have in Mr. Magrath's carrying out the work of his new position.

Reverend Canon H. J. Cody, responding to this toast, very ably outlined the privileges of "service" and showed how high ideals in this respect had resulted in the advancement of all branches of scientific and professional activity. Canon Cody elaborated the doctrine often expressed in the phrase that 'virtue is its own reward', and he gave instances where unselfish effort on the part of professional researchers and others had contributed to the general welfare of mankind.

Senator C. D. Clarke, of Washington, D.C., Chairman of the United States section of the International Joint Commission, and a colleague on that body with Mr. Magrath, spoke briefly in appreciation of the high esteem in which Mr. Magrath was held by his colleagues and congratulated the Hydro-Electric Power Commission on its new Chairman.

Premier G. Howard Ferguson proposed the toast to the Province of Ontario and to the Hydro-Electric Power Commission. Mr. Ferguson spoke most highly of Mr. Magrath's record and of his fitness to discharge the duties of his new position. The Prime Minister showed a clear and comprehensive understanding of the work of the Hydro-Electric Power Commission as he recounted its early history, its progress, its present achievements and its future possibilities. Looking to the future, Mr. Ferguson expressed the hope that early action might be obtained in making the water powers of the St. Lawrence available to meet the pressing power demands of the Province, and gave assurance that his Government was doing, and would continue to do, everything in its power to further this end.

Rising to speak, Mr. Magrath was greeted with heartiest applause and in his address he stated that the providing of additional sources of electrical energy for the municipalities of Ontario was a matter that was receiving the definite and most careful consideration of his colleagues and himself. Mr. Magrath expressed the belief that probably the best means of relieving the present shortage would be to secure additional allotments of water from the Niagara river to be used by both nations to operate to full capacity power plants on both sides of the river in which there was at present machinery standing idle because water—under

the appropriations of the Boundary Waters Treaty—was not available to operate it. Mr. Magrath believed that such allotments could be secured as a temporary measure.

Mr. Magrath, regarding the steam plants, stated that it was fully recognized that steam plants had an important place in connection with the work of the Commission, but he did not wish anyone to regard steam plants from the standpoint of being a solution of the problem of power shortage.

Mr. Magrath emphasized the importance of the St. Lawrence river as the principal source from which additional power could be obtained. He said he saw no reason why the development of water powers on the St. Lawrence river should be held back until the two federal governments concerned had come to final detailed decisions respecting what they desired to do ultimately in the matter of navigation. Mr. Magrath showed that power could be developed without in any way interfering with such navigation development as the two countries might decide to proceed with at a later date.

Mr. Magrath expressed the belief that there should be no difficulty in the Province of Ontario getting on common, co-operative ground with her sister Province of Quebec. He said, further, that the time will probably come in Canada when there will be a great power artery extending possibly from the city of Quebec on the east to Windsor on the west.

Mr. Magrath opened his remarks by referring in terms of highest appreciation to the vision and work of Sir Adam Beck and throughout the course of his address made frequent references to what Sir Adam had accomplished and as Mr. Magrath said, it was his own desire "to shoot at the same target as had been set up by Sir Adam Beck". He said that his colleagues and himself were determined that all the available water resources should be employed to serve the electrical needs of the municipalities and citizens of the Province of Ontario.

Winter Convention
O.M.E.A. and A.M.E.U.

at King Edward Hotel, Toronto
January 20 and 21, 1926.

Developments of the Hydro-Electric Power Commission of Ontario

By Frederick A. Gaby, Chief Engineer, H.E.P.C. of Ont.

(Paper read before the American Society of Civil Engineers at Montreal, October 14, 1925)

IN submitting on this occasion a brief description of the power developments of the Hydro-Electric Power Commission of Ontario, it is my desire to present this description in what may be termed its general historical and economical relationship to the programme of public service as expressed by the work of the Commission. Such a course will, I believe, contribute to the establishment of a more correct understanding of the Commission's work and enable you to recognize the continuity of policy that has actuated the Commission in obtaining and supplying electrical energy to meet the rapidly growing municipal, industrial, commercial and domestic needs of the citizens of Ontario. An organization which only commenced to supply electrical energy in 1910 with a small initial load of less than 1,000 horsepower and which, fifteen years later, is distributing about 800,000 horsepower and operating twenty-three plants which, when fully developed, will have a potentiality of over 1,000,000 horsepower, could not have progressed to its present magnitude and stability without following some well-defined policy.

Now, the hydro-electric enterprise of Ontario has sometimes been referred to as a government-owned undertaking, but at the outset I wish to make just as clear as words can that the phrase "Government ownership" as frequently employed elsewhere—and as often employed in the United States—has a significance radically different from any conception that should be attached to the operations of the Hydro-Electric Power Commission of Ontario. Ontario's great hydro-electric undertaking is a co-operative municipal-ownership enterprise operating through the agency of independent Commission control and administration, and has been removed from political influence.

In making this introductory comment, I trust it is not necessary to disclaim any intention of evoking controversy upon the question of public ownership. I have no quarrel with those who honestly cannot subscribe to the basic doctrines of public ownership, nor would I, irrespective of the governing factors, undertake to hold a general brief on behalf of public ownership, but as referred to above, I do strongly maintain that public ownership honestly administered and for the circumstances existent in the province of Ontario, public or municipal ownership as expressed in the work of the Commission is eminently satisfactory, and on behalf of the citizens

of the Province renders a service which, I believe, is unequalled in any other comparable territory.

It is here necessary to refer incidentally to certain features of the Commission's administration, but only in so far as they, for the purpose of this discussion, contribute to an understanding of the policy followed by the Commission in constructing its various power developments.

Broadly speaking, the Hydro-Electric Power Commission is entrusted with the duty of supplying efficiently the electrical needs of the citizens of Ontario municipalities at the lowest possible cost. At first this end was achieved most efficiently by purchasing the power from existing sources of supply. Sometimes the source of supply itself has been purchased outright by the Commission. Sometimes a number of generating plants have been purchased along with an existing electric network and this has constituted the basis from which extensions have been made. Finally, the Commission has made its own hydro-electric developments. At the present time the Commission is considering the desirability of obtaining a substantial quantity of electrical energy by means of steam power.

Financial Structure

Certain principles which the inaugurators of the Hydro undertaking believed sound, and which have since proved to have met all anticipations, were laid as a basis upon which to administer the various assets in which the municipalities are concerned. The general system of administration may briefly be summarized as follows:

First: The generation and transmission of power on a wholesale scale is dealt with by a Commission which, although appointed by the Government of the Province, acts independently in the capacity of trustee for the partnership of municipalities.

Second: The local distribution of electrical energy within the borders of each municipality is, in general, under the administration of a public utilities commission appointed under the provision of the Public Utilities Act.

Third: Capital required for the plant for the generation and transmission of power is loaned by the Government upon receipt of formal requisition from the Commission. Contracts are entered into between the Commission and the municipalities under the terms of which the municipalities undertake to repay over a period of thirty years the monies thus loaned by the Government with interest in full.

Fourth: The local distribution system is financed by the issue of municipal debentures. Provision is made in the rates charged to the ultimate consumers, for revenue with which to retire these bonds also in twenty to thirty years.

Fifth: The Commission supplies power to the municipalities, charging each municipality the actual cost. To do this, an interim charge is made monthly

based upon the estimated cost and, at the end of each year, credit or debit adjustment is made of the amount charged in order to make up the actual total cost. The "cost of power" includes all the usual costs of operation and maintenance of the generating, transforming and transmission plant and equipment, and, in addition, the annual interest charges on the monies borrowed for the initial cost of installation, also provision for renewal (depreciation) and sinking fund reserves, as well as a special reserve fund for contingencies.

Sixth: Each municipality sells electrical energy to its own local consumers at rates and under conditions approved by the Commission. The rates charged to its consumers by a municipality are made sufficient to take care both of the cost of distribution, within the municipality, and of the estimated cost of power to be paid to the Commission by the municipality. The cost of distribution is ascertained in a manner identical with that used by the Commission in arriving at its wholesale costs.

Seventh: Under the Power Commission Act, the Commission is required to determine, annually, the actual cost of service supplied to the municipal corporations by the local commission for such strictly municipal purposes as street lighting and the operation of waterworks' pumps and street railways, and if any profit has accrued through the charging of the rate used throughout the year, this surplus is returned to the municipality.

The basic conception of the whole municipally-owned, electrical undertaking as administered by the Hydro-Electric Power Commission of Ontario is a partnership of municipalities formed to obtain power at cost, each municipality paying its proportion of the cost for the service received. The Commission, acting as agent and trustee for the municipalities, exercises both administrative and constructional functions, and by application of the principles adopted, has evolved a well-defined and successful working policy for the development, transmission and distribution of hydro-electric power under municipal ownership.

Sources of Power Supply

In 1908 the Commission, in view of the vested interests in power developments at Niagara, secured its first electrical energy for supplying the municipalities of the Niagara system by contracting with the Ontario Power Company for a supply of electrical energy up to a maximum of 100,000 horsepower at a price of \$9.40 per horsepower-year until a load of 25,000 horsepower should be reached after which the price would be \$9.00 per horsepower-year. This 100,000 horsepower was utilized by 1915. The Commission arranged for additional power from other companies, and in 1917 purchased outright the Ontario Power Company with its plant capacity of over 160,000 horsepower. In 1920, the plant of the Toronto Power Company

with over 125,000 horsepower capacity was purchased, and at the present time the Commission is completing its own Queenston-Chippawa plant with a capacity of over 550,000 horsepower. All these provisions were made to supply power to the Niagara system.

From time to time various municipalities in districts adjacent to other sources of hydro-electrical energy requested the Commission to take action with a view to supplying their power needs. Thus separate systems were formed in localities in general proximity to various sources of power supply.

Concurrently with its efforts to keep pace with the continually increasing demand for power on the Niagara system, the Commission found it necessary to construct power developments for many of the other systems, which were experiencing corresponding growth in demand for electrical energy. These developments differ not only in physical characteristics but also in their economic relationships to the various systems which they supply as well as to the Commission's undertaking viewed in the large.

At the present time there is a tendency to reduce the number of separate systems by a process of consolidation. This has been brought about by the expansion of the various systems and the extension of their transmission networks to a point where they interlocked with those of other systems. When this stage in their growth was reached, it became advantageous to connect by tie lines the adjacent systems. In some cases, special tie lines were run to transfer energy from one generating station to another. Thus two or more systems became physically one from an operating standpoint. Finally, when this stage was reached, it was found advantageous to extend the consolidation to include the financial and administrative features. Both from the operating and administrative viewpoint the consolidations made have effected substantial economies.

In some cases the Commission purchased the properties of companies which were operating within the confines of a system already established by the Commission. For a time these properties were operated as separate entities, but as it became convenient they were absorbed into, and co-ordinated with the larger systems. These consolidations also effected economies in operation and administration.

Systems Operated by the Commission

At present, the Commission operates the following systems:

The Niagara System: This embraces all the territory lying between Niagara Falls, Hamilton and Toronto on the east, and Windsor, Sarnia and Goderich on the west, as served with electrical energy generated at the several plants on the Niagara River. These include the Ontario Power Company plant, the Toronto Power Company plant and the new Queenston-Chippawa development. The area served by this system is about 13,500 square miles, with a population of 1,800,000 and the load supplied is about 700,000 horsepower.

Georgian Bay System: This system which is a consolidation of four systems previously existing—namely, the Severn, Eugenia, Wasdells and Muskoka systems—serves that portion of the Province of Ontario which surrounds the southern end of Georgian Bay and lies to the north of the territory served by the Niagara System. It includes the district surrounding Lake Simcoe and extends as far north as Huntsville in the Lake of Bays District. It is served by five generating stations, the Wasdells and the Big Chute on the Severn River, the Eugenia on the Beaver River, and the South Falls and Hanna Chutes developments on the Muskoka River. Of these, the Big Chute plant was purchased from the Simcoe Railway and Power Company and subsequently enlarged by the Commission. The South Falls plant was purchased from the town of Gravenhurst and is also being enlarged, while the other three plants were constructed by the Commission. In addition, power is purchased from the corporation of Orillia, and from the Niagara System. The area served by the Georgian Bay System is about 8,900 square miles, with a population of 115,000 and the load supplied is about 20,000 horsepower.

St. Lawrence System: This serves the district immediately to the north of the St. Lawrence River between Brockville and Cornwall. The supply of power for the system is purchased under agreement from the Cedar Rapids Power Company which generates its power at Cedar Rapids on the St. Lawrence River, delivery being made at a point near Cornwall. The area served by this system is about 2,100 square miles, with a population of 28,000 and the load supplied is about 6,000 horsepower.

Rideau System: This system serves the district in the vicinity of Smith's Falls, Perth and Carleton Place. Power is available from two generating plants, one at Carleton Place and the other installed by the Commission at High Falls. Both are situated on the Mississippi River. The Commission also purchases power from the Rideau Power Company of Merrickville. The area served by this system is about 1,500 square miles, with a population of 16,350 and the load supplied is about 3,000 horsepower.

Thunder Bay System: This system serves the district at the head of the Great Lakes, including the twin cities of Port Arthur and Fort William, with power from the power development at Cameron Falls on the Nipigon River. The area served by this system is about 4,000 square miles, with a population of 17,000 and the load supplied is about 45,000 horsepower.

Ottawa System: This system serves the city of Ottawa, and an extensive rural power district adjacent thereto. Power is purchased from the Ottawa and Hull Power and Manufacturing Company under an agreement whereby 20,000 horsepower is provided. The present load is about 16,500 horsepower and the population served is about 134,650.

Central Ontario and Trent System: This system serves the district bordering the north shore of Lake Ontario lying between the territory on the west served by the Niagara

and Georgian Bay Systems and that on the east served by the St. Lawrence and Rideau Systems. The nucleus of this system was the group of properties formerly controlled by the Electric Power Company, Limited, and operated by it through the agency of twenty-two subsidiary companies. These properties were all purchased by the province of Ontario on March 1, 1916, and have been operated by the Commission as trustee for the Province since June 1, 1916. Since that date the system has been greatly enlarged in order to meet the constantly growing needs of the district.

The power supply for the Central Ontario and Trent System is obtained from nine power developments situated on the Trent and Otonabee Rivers. The power developments are made in conjunction with dams required for navigation purposes. Two of these are new developments that are now under construction at Dams No. 8 and No. 9. The area served by this system is about 4,700 square miles, with a population of 145,000 and the load supplied is about 45,000 horsepower.

Nipissing System: The Nipissing system comprises the town of North Bay and certain small municipalities south of lake Nipissing. It was purchased by the Province with the Central Ontario system in 1916 and has since been operated by the Commission. It is supplied with power from two hydro-electric developments on the South river at Nipissing and Bingham Chute. The area served by this system is about 700 square miles, with a population of 13,500 and the load supplied is about 2,750 horsepower.

What has been already said will have outlined to you the general purpose and duties of the Commission in its service to the co-operating municipalities. You will have understood the fact that it is not a "government-owned", but a municipally-owned undertaking operated by an independent Commission and free from political influence. The financial structure has been briefly outlined. You have noted the various steps taken to obtain the power required by purchase; by acquiring generating companies; and by actual construction of generating plants by the Commission. You have also noted the process of consolidation taking place in the Commission's systems. We shall now turn to a consideration of the noteworthy features of the hydro-electric developments actually constructed by the Commission.

Early in 1912, on the application of a number of municipalities in Ontario county situated on the east side of the lake Simcoe, the Commission made a thorough survey of the available water powers in the district, and recommended a site at Wasdells Falls, on the Severn river about three miles below lake Couchiching, as being the most economical for power development. The interesting feature of this development is that it marked a new step in the progress of the policy of the Commission in that it was the first development constructed by the Commission on behalf of municipalities. Work was commenced

in July, 1913, and the project was completed in September, 1914.

WASDELLS DEVELOPMENT:

The detailed hydraulic investigations showed the available head to vary considerably, owing principally to back-water effects. However, taking into consideration the effect of forebay levels, the maximum and minimum heads available after construction were determined to be approximately 15 ft. and 9 ft. respectively.

Except for difficulties encountered due to this extremely low head, all the inherent features of the site were very favorable for development purposes. The natural formation is solid granite, affording an excellent foundation for superstructure.

The dam sub-and super-structure (Fig. 1) are constructed of mass and reinforced concrete, and offer no special features of design. The two main turbines are of vertical double-runner type in open-flume setting, and each runner is provided with a separate draft tube. The units are designed to operate normally at a speed of 90 rev. per min. under a head of twelve feet, when the guaranteed capacity at three-quarter gate is 600 horsepower. When operating under nine foot head at full gate the guaranteed capacity is 500. horsepower. The guaranteed efficiencies vary from 75 to 85 per cent. for gate openings of from 50 per cent. to 100 per cent. The main generators are of the vertical, three-phase, 60-cycle type, and each is

Fig. 1. Wasdells Power House, First development made by Hydro-Electric Power Commission of Ontario.

of 400 kilovolt-ampere capacity with the usual guarantees and specifications.

EUGENIA DEVELOPMENT:

The second development undertaken by the Commission, situated on the escarpment near Georgian Bay, in the County of Gray, and designed to serve the municipalities in the Owen Sound-Durham district, was commenced in July, 1914, and the initial development completed in November, 1915, (Fig. 2). The unique features of this plant, known as the Eugenia development, are the arrangements for maximum economic utilization of the runoff from the drainage area, and the high head under which reaction turbines are used.

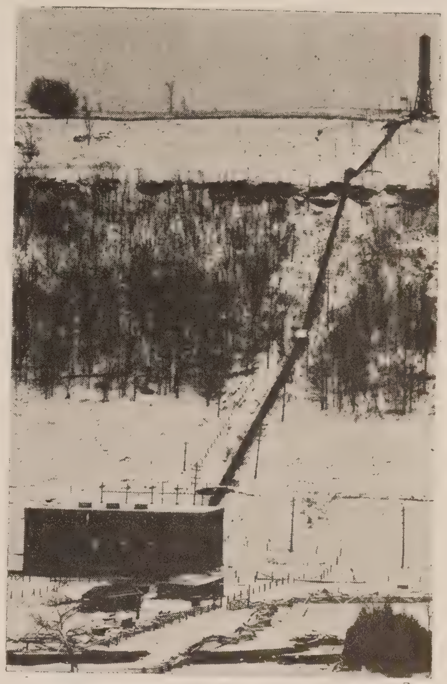


Fig. 2. Eugenia Development before second pipe line was added.

The development consists essentially of a storage dam on the Beaver river about one-half mile above the Eugenia Falls, forming a reservoir, a canal 5,000 feet long, a forebay or settling basin, two woodstave pipes and steel penstocks and the powerhouse. The gross head under which the plant operates is 552 feet, which is obtained from the storage dam of 50 feet and the natural fall of the river.

The drainage area above the storage dam is 74 square miles, a great deal of which is tamarack and cedar swamp. The runoff is remarkably constant, due partly to the above fact, and partly to the geological formation. The escarpment is Lockport dolomite underlying Cataract limestone, the whole overlaid with thick beds of morainal boulders, gravel and clay, and this top covering forms a vast natural equalizing reservoir. The rainfall on the drainage area is above the normal for southwestern Ontario, since it lies on the high plateau between the Georgian Bay and Lake Ontario, being about 39 inches per annum. The storage provided at the dam, together with the natural regulation of the stream, will allow of the use of a runoff of about one second-foot per square mile throughout the year. The maximum flood runoff, as recorded during the past five years, is only about 7 second-feet per square mile, while the minimum record runoff is .27 second-feet per square mile.

The main storage dam, or No. 1 dam, is a reinforced-concrete structure of the Ambursen type. The

total length of the structure is approximately 1,900 feet, of which 1,260 feet is reinforced concrete and 640 feet is earth embankment with concrete core-wall. The reinforced section is approximately 51 feet high from bottom of cutoff to top of crest at the highest point. The crest of the spillway is at elevation 646, and its length 103 feet. The maximum elevation to which the water is raised is elevation 649, at which point an area of about 1,650 acres is flooded. This upper three feet is controlled by flashboards, and the capacity gained by this means is 190 million cubic feet, while the total storage capacity of the dam is 780 millions, or about one-third of the total flow of the river in a normal year.

The canal connecting the reservoir with the headworks and woodstave pipe lines is constructed as an open trench protected by wooden box flume in locations subject to earth-slides. At the lower end of the canal a natural basin was made by placing an earth-fill dam across an opening in the valley. The length of this dam is some 800 feet, its maximum height 30 feet, and its width 10 feet at the top, with slope of three to one on the water side and two to one on the lower side. The two woodstave pipe-lines are 46 inches in diameter and some 3,350 feet in length, ending in surge tanks located at the brow of the escarpment above the power house.

The woodstave and steel pipe lines are joined by head blocks, from which risers of 40-inch diameter connect with surge tanks, which are designed to handle without spilling a complete shutdown of the plant when all units are operating.

The steel penstocks are 52 inches in diameter, 1,557 feet in length, and vary in thickness from 5/16 inch at the upper end to 27/32 inch at the lower end. The girth seams at the top are single-rivetted and at the lower end double-rivetted; the longitudinal seams are triple-rivetted double-butt-strap joints, with rivets varying from 3/4 inch to 1 1/4 inches. The penstock i supported by concrete saddles every 20 feet, and rides on steel channels bent to the outer radius of the pipe. Four concrete anchors are placed at changes in grade below the head-blocks, and at end of the first three anchors are placed expansion joints of the stuffing-box type. The penstock is housed for about half its length to protect against frost.

The penstocks supply three spiral-casing, single-runner turbines, two of 2,250 horsepower capacity at 540 foot head operating at 900 rev. per min., and one of 4,000 horsepower capacity.

Two of the generators are rated at 1411 kilovolt-amperes and one at 2800 kilovolt-amperes, 3-phase, 60 cycles, 3800 volts. Based on the machine ratings the capacity of the whole development is 7,500 horsepower.

Queenston-Chippawa.

It appears apropriate next to refer to the most important development that the Commission has made, which is the Queenston-Chippawa development on the Niagara river. As already intimated, the supply of power made available by purchase

from the Ontario Power Company at Niagara was fully in use, and the Commission was faced with the menace of an oncoming power shortage. This shortage materialized about 1918, and was pronounced until relieved in 1922 from the new plant which I am about to describe.

In order to meet the growing demand for electrical energy for industrial purposes, the Hydro-Electric Power Commission, in 1917, commenced the Queenston-Chippawa development. This plant was designed originally to utilize the surplus water that was available out of Canada's allotment of 36,000 cubic feet per second under the Boundary Waters Treaty, but when the Commission acquired by purchase the Niagara plants of the Ontario Power Company and the Electrical Development Company, the size of the projected new Queenston-Chippawa plant was increased from less than 200,000 horsepower to about 450,000 horsepower, and eventually to about 550,000 horsepower. This enlargement was possible because more water was available for use under much more efficient conditions. That is to say, in the Queenston-Chippawa plant the water could be used at nearly double the head.

The general scheme of development comprises an intake structure in the Niagara river at Chippawa; the deepening of the Welland river for a distance of 4-1/2 miles; the construction of a Canal 8-1/2 miles long from Montrose to the forebay and screen-house, which are located on the cliff about a mile south of the village of Queenston, and the construction of the Power House in the Gorge.

Throughout the period of preliminary study and later as the design progressed, continuous use was made of models of the various structures in order that the mathematical analyses might be augmented by actual demonstrations under the assumed conditions. Models were made for the studies of the intake, the bends in the canal, the transitions, that is, points where change of section occurred in the Canal, the diffuser at the mouth of the forebay, and of the draft-tubes and station substructure. It is believed that the beneficial results of such studies and of the care taken in the design of what are often considered minor elements of a power development have been demonstrated by the results obtained. Such tests as have already been made indicate conclusively that there has been secured at least as high an over-all efficiency as has ever before been obtained.

True conservation of the waters of the Niagara river for power purposes demands that practically the whole fall of about 327 ft. between Lake Erie and Lake Ontario be utilized. The various power plants now operating at Niagara Falls utilize heads of from 130 ft. to 210 ft. only and with widely different degrees of efficiency. The Queenston-Chippawa power development, the first unit of which was placed in operation during December, 1921, will have a normal operating head varying from 294 to 305 ft. when the installation is complete. The conservation of head effected by the reduction of hydraulic losses to a minimum (Fig. 3) and

by refinements in the design of the various essential elements of the project as a whole, has resulted in a power development which is believed to represent the best in modern engineering practice.

Fig. 3. Birds eye view of Queenston-Chippawa Development showing route of canal to utilize total drop of Niagara Falls and Rapids.

The present installation will consist of nine 55,000 to 65,000 horsepower turbine units operating at 187.5 rev. per min. The generators are of 45,000 to 55,000 kv-a capacity at 12 kv., 3-phase, 25 cycles, with an ultimate aggregate capacity of from 450,000 to 550,000 horsepower, depending upon water levels. The electrical energy is stepped up from 12 kv. to 110 kv. for transmission.

Intake

One of the great obstacles to be overcome in order to secure continuity of service is the entry of ice into the Canal. Great fields of ice, formed in Lake Erie with its shallow bays and sloping shores, are discharged down the Niagara river every Spring, and at frequent intervals during the Winter. The river itself never freezes over, but considerable anchor and frazil ice are formed at times of low temperature.

The site of the intake of the Queenston-Chippawa power development, at the mouth of the Welland river, is favourable in that floating ice does not ordinarily follow the shore lines at this point; but the smooth gradient of the river surface, and the comparatively shallow water with its low velocity, are unfavourable to the proper handling of ice.

The removal of water in large quantities from a river heavily charged with ice is always a difficult problem, but is greatly simplified when a natural break in the river surface, accompanied by a sudden drop, gives a source of power for the separation of floating ice, and for its continuous disposal. The use of a horizontal diaphragm to skim the surface water, with its burden of ice, from the lower strata, thus permitting the upper water layer to be accelerated and removed clear of the intake without objectionable eddies, while the lower layer, free of ice, is changed in direction and flows through the intake into its new channel, gives a positive and satisfactory solution.

When the natural conditions do not permit such an arrangement, radically different measures, as in the present case at Niagara, must be taken. To confirm certain ideas developed as a result of many years of experience and observation by the Commission's engineers in connection with the present plant operating on the Niagara river, an extended series of tests and experiments was made on large-size models. These models are duplicated to scale the topographical conditions at the site of the intake. The result of these experiments contributed to the preparation of a design which, it is expected, will operate in such a way as to keep the plant free of this ice menace.

Fig. 4 shows the physical nature of the intake design. The complete intake structure is about 1,100 ft. in length and is made up of an entrance with lock gates for navigation, a bulkhead section and the intake proper, the latter combining two forms of intake. The conventional or surface intake consists of a concrete barrier or boom with fifteen openings each 18 ft. in width, having normally 8 ft. of submergence, which however, by means of drop gates can be increased to any amount up to the full depth of water, or 35 ft. The

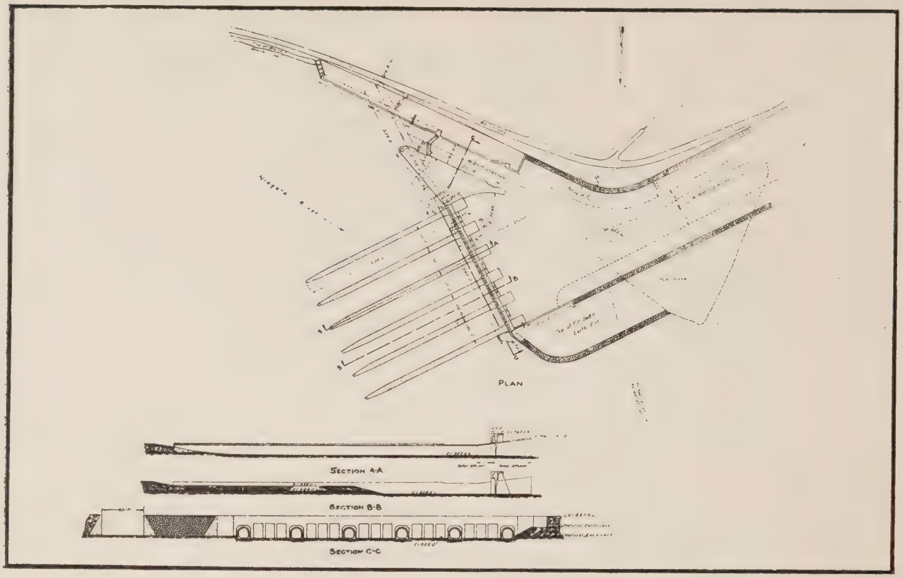


Fig. 4. Plan and Sections of Intake at Mouth of Welland River.

submerged intake consists of 6 gathering tubes or draft distributors, aggregating 675 ft. in length. Water enters the tubes on the upstream side through slots along a distance of 500 feet. These tubes are controlled by gates similar to those on the surface intake—air tubes comprise an outer tapering section wherein the velocity is maintained constant, with a longer inner section of twenty-foot diameter wherein the velocity increases regularly with respect to distance along its axis. Diffuser sections are situated at the inner end to reduce the velocity, with as little loss as possible, to correspond with that in the Welland river section.

The submerged tube section of the intake was designed as an ultimate protection against ice, and its installation would be undertaken provided it was found that the present construction proved inadequate. Up to the present time it has satisfactorily taken care of ice diversion.

The Canal

For many miles above its mouth the Welland river is a sluggish stream, meandering slightly in a depression that can hardly be called a valley. This stream for 4 1/2 miles forms the first reach of the canal, and its low banks provided a suitable disposal area for much of the material excavated in the process of straightening and deepening the channel. Leaving the river channel near the crossing of the Michigan Central Railway the Canal takes a course almost due north for over three miles, as shown in Fig. 3. The earth over-burden is quite heavy for the whole of this portion of the canal, the bottom grade of the earth section of the Canal meeting the

rock surface one mile from the Welland river. The maximum rock elevation is not coincident with the maximum earth surface elevation but the profiles of rock and earth surface are roughly parallel to each other. Just beyond Lundy's Lane the maximum bend in the Canal occurs, having a deflection of 51 degrees, and, at intervals of a little over a mile each, there are two other bends of 27 and 31 degrees. The earth over-burden continues fairly uniformly for three miles beyond Lundy's Lane until Bowman's Ravine is reached.

The ravine is apparently an old river channel through which, in preglacial times, the Niagara river flowed toward Lake Ontario. At the time the construction started this old channel was the course of a small stream having its outlet at

Fig. 5. Canal in Rock Section.

the Whirlpool. The ravine crossing is made on a fill and the ravine itself proved a convenient disposal area for about 1,500,000 cu. yds. of excavated material.

Where the canal section again enters the rock cutting beyond the ravine, the earth over-burden becomes very light, in some places amounting to only a foot or so. Two deflections are made in the remaining two miles of the canal, one of 33 and the other of 47 degrees. A quarter mile beyond the second of these curves the forebay is reached.

The Design of the Earth and Rock Sections. Long continued investigations were made of available information on factors of roughness for large canals in earth and rock,—with and without concrete lining. One of the conclusions reached was that the "Kutter," formula should be used. The roughness factors used in the hydraulic studies were 0.035 for the river section and 0.012 for the concrete-lined rock section.

Control Works. An electrically-operated Roller sluice gate of 48 ft. clear span—the full width of the rock section—is located at station 97+00 which is near the beginning of the rock section. The use of two gates with a central pier was considered, but the single gate was found to be the more advantageous, as it provided an unobstructed waterway with a consequent reduction in friction losses. The gate (Fig. 6), which is supported on steel towers with a concrete substructure, weighs about 100 tons, and is provided with two hoisting mechanisms and two counterweights. When the gate is at the top of its run it is high enough above the water surface in the canal to permit a tug to pass beneath.

Whirlpool Section. Bowman's Ravine, situated west of the whirlpool, was crossed on a rock fill, the cross-section of the canal being changed from a rectangular section 48 ft. in width to a trapezoidal section with 10 ft. bottom width and side slopes of 1 on 1-1/2. This cross-section was designed to give as great a cross sectional area as the rock section has at the extreme minimum water level. The whirlpool section is lined with reinforced concrete. In order to withstand the pressure of the back water when the canal is emptied, the lining is provided with vents of sufficient size to drain the fill as quickly as the water can be drawn down in the canal.

Concrete Lining. Economic considerations prompted the lining of the rock section of the canal with concrete. The height of the lining was fixed slightly lower than the profile of the water surface existing when the load conditions on the plant are at a maximum and the flow in the Niagara river is at a minimum. Thus, at all times, the lining will be protected by submergence against the action of frost. The thickness of the lining varies according to the rock over-break but averages about 20 in., and where necessary, steel dowels are used to anchor the concrete lining to the rock.

Extreme smoothness of surface is not the only determining factor, precise alignment being also a most important element in the reduction of hydraulic losses. Great care was taken to obtain a smooth surface

Fig. 6. Electrically operated Roller Sluice Gate, slightly opened.

by the use of steel forms and for this purpose a positive and rigid method of form setting was devised. This insured almost perfect alignment.

(Continued in December Number)

Calculation of Currents and Impedance Drops in Loop Circuits

By W. B. Buchanan, Asst. Laboratory Engineer, H.E.P.C. of Ontario.

IN view of the fact that as far as we are aware, it has been considered very difficult to calculate the current distribution and impedance drops in feeders connected in loops or to estimate the line losses with any degree of confidence, we believe that the following method which has been devised by the writer and checked by actual tests in the laboratory, will prove of value and is outlined herein for the guidance of any engineer who may find it necessary to make such calculations. The method involves calculations by first and successive approximations but for ordinary distribution circuits of less than ten per cent voltage drop, the first approximation may be sufficiently accurate, even less than one per cent error under some conditions of loads and power factors. For conditions of heavy loads and low power factor, however, further calculations would probably be necessary to obtain a reasonable degree of accuracy.

The essential features of the theory, which does not follow along well known standard lines is as follows:

If in any section of a circuit we have a current I flowing through an impedance Z (vector quantities assumed) the impedance drop is equal to IZ. Owing to the linear relation between impedance drop and current, it is obviously permissible to consider I as consisting of any number of components independent of each other except for the fact that $I_1+I_2+\quad+$ must equal I. Then it is clear that $IZ=(I_1+I_2+\quad+\quad)Z$ and by estimating I_1, I_2, etc., which are components of the various loads on the loop, we obtain I for any section and hence the impedance drop and line losses for that section.

Problem:

Assume a loop circuit as shown in Fig. 1 with generating station at G and loads at A, B, C., etc.

This diagram may be assumed to represent one phase only, or the single-phase equivalent of any three phase circuit giving Z_1, Z_2, etc., the correct values for each case.

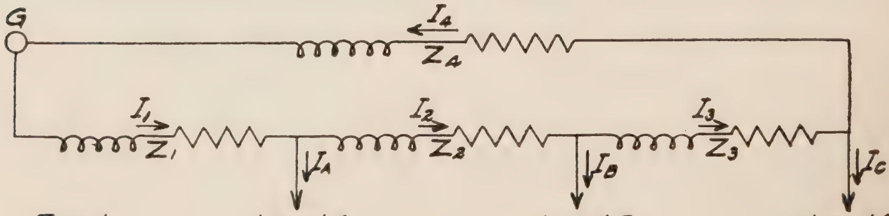


Fig. 1

For high tension, long distance lines, the effective value of load A must be taken at the high tension bus. The high tension equivalent of the secondary load is first found, compensation made in the power factor to allow for the impedance drop in the transformer, the exciting current of the transformer added to the load current, also one half of the charging current to the lines taken by each section adjacent to the station. For sections of fifty miles or less the errors introduced by assuming one-half of the electrostatic capacity lumped at each end of the line are negligible.

Then considering load A only from station G there are two paths for the current, Z_1, in parallel with $(Z_2 + Z_3 + Z_4)$.

Component of I_A through Z_1, say

$$I_A' = \frac{I_A(Z_2 + Z_3 + Z_4)}{Z_1 + (Z_2 + Z_3 + Z_4)}$$

Component of I_A through $Z_2 + Z_3 + Z_4$, say

$$I_A'' = \frac{I_A \times Z_1}{Z_1 + Z_2 + Z_3 + Z_4}$$

These components will be obtained with reference to the voltage at A say V_A.

Similarly components of I_B may be found with reference to V_B.

$$\text{i.e. } I_A' = \frac{I_B \times (Z_3 + Z_4)}{(Z_1 + Z_2 + Z_3 + Z_4)}$$

$$I_B'' = \frac{I_B \times (Z_1 + Z_2)}{Z_1 + Z_2 + Z_3 + Z_4}$$

and in like manner for all loads on the loop.

Our first approximation is obtained by assuming that the reference voltages V_A, V_B, V_C, etc., are exactly in phase with each other and the several components of current found for each section may be added vectorially using the expressions already found thus.

$$I_1 = I_A' + I_B' + I_C'$$
$$I_2 = I_B' + I_C' - I_A''$$
$$I_3 = I_C' - I_A'' - I_B''$$
$$I_4 = -I_A'' - I_B'' - I_C'$$

Thus the magnitude of error in the assumption may be determined by calculating I_2Z_2 of which the quadrature component is a measure of the phase difference between V_A and V_B, which was assumed to be zero. Using such phase differences found (if any) to obtain the correct vector expression for I_B and I_C with respect to V_A instead of to V_B and V_C as formerly used brings the results on a second calculation to a much greater accuracy because the same reference vector is used.

In many cases the second calculation may not be necessary, for example if loads, A, B and C have nearly the same power factor the numerical value of the line currents would not be altered appreciably even with six or eight degrees in phase shift between voltages of A, B and C.

This method of calculation has been checked by tests in the Laboratories on a small model loop transmission line with three loads, lagging, leading and unity power factor at 110 volts and the final results checked as closely as could be expected from the accuracy of the tests results. It should be noted that very careful attention must be given to the algebraic symbols to avoid possible errors from such a source.

Note: Since the above solution was worked out, an article in the Electric Journal (April, 1924) by

R. D. Evans on "Analytical Solution of Networks" introduces the principle upon which this solution is based under the heading "Superposed Solutions", page 153. The author confirms our finding that any two solutions for a given network for different combinations of loads and sources may be superposed, giving a solution for a third combination of loads and sources. Currents and impedance drops are added vectorially. Succeeding numbers may introduce further similarity in the method but at present writing the remaining sections of the problem treated by Mr. Evans are different.

Uniform Structure for Electric Rates

By Philip Chaplin Jones, Akron Ohio

The following article on rate structure re-printed from the November 14th issue of the "Electrical World" will be of considerable interest to the readers of the Bulletin, as it will be recalled that from the beginning of Hydro-Electric service in Ontario, the Commission has authorized a multi-factor system of rates for all classes of service, believing that in that way only could service be supplied at cost. While the rate structure has, of necessity, been modified, in detail, from time to time, to meet changing conditions of service, the principle of a step rate has been adhered to by the Commission from beginning of operation.

This article indicates that the author has given the subject considerable study in respect to the analysis of conditions as they exist to-day, or as the trend of electrical developments indicate, and the effect of these upon an adequate or equitable rate system.

WITH the rapid growth of electric public utilities the question of equitable rates and charges became of increasing importance. It was early recognized that the electrical-generating companies were natural monopolies and thus that their profits were not subject to the control of competition. The only other evident curb was government control, and the various states rapidly arose to the occasion and created state public utility commissions, delegating to them rate-adjusting powers in various degrees.

Inequalities in existing rates were apparent. The situation was aggravated by lack of standards of comparison. Conditions and costs were different, of course, in different localities and these natural inequali-

ties when presented in the frames of heterogeneous accounting systems presented appearances in no way alike.

The first step in the amelioration of this unfortunate situation has already been taken. The state utility commissions, banding themselves into a national association, have formulated a standard classification of accounts with instructions as to its use. Most of the states have adopted or are about to adopt a standard classification either identical or very similar to this one.

Thus the time is in sight when the public utilities will speak a common financial language. One big step yet remains—to formulate a standard rate structure whereby these costs now arranged and classified in a uniform manner may be charged out to the consumer in an equitable and uniform way. It is as a suggestive guide in this direction that the present article is written.

All expenses of an electrical utility may be divided into three groups, each group being, in general proportional to one of the three main elements in the business: the first to the size of the plant, the second to the number of production units generated, and the third to the number of customers. Viewed in this manner the three groups of expenses will be as given below:

Group I—Capacity Charges. Interest on indebtedness, taxes, insurance, depreciation, general office expense, power plant labor and allowable profits. This includes accounts numbered 701, 706, 709, 721.1, 721.2, 731.21, 731.31, 781 to 790 inclusive as given in the Uniform Classification of Accounts for Electric Utilities published by the National Association of Railway and Utility Commissioners. Also 403, 404 and 431 to 443 inclusive.

Group II—Energy Charges. Costs of fuel, supplies, maintenance, transmission and distribution losses. This includes all accounts numbered 702 to 705 inclusive, 707, 708, 710, 711, 712, 721.3, 721.4 to 721.9 inclusive, 731.22, 731.32, and 731.4 to 737.71 inclusive in the same classification.

Group III—Customer Charges. All charges proportional to the number of customers, such as meter and billing costs. This includes accounts numbered 731.51 to 731.54 inclusive, 732.72 and 760 to 771 inclusive, also in the same classification.

To charge out these costs fairly a three-fold rate must be used. In the early days of the industry, the attempt was made to keep the rates as simple as possible. It was thought advisable to have a flat rate per kilowatt-hour or per horsepower year. The feeling was that a more complex rate, though it might better represent the actual cost of service, would be for the most part unintelligible to the customer and therefore distasteful to him. We have fairly well outgrown this situation now, however, and very few of the simple one part rates still exist. In the whole business world the tendency is more and more to make selling price correctly proportional to costs and in the future it will undoubtedly be easier to defend a just rate, no matter how complicated, than an unjust one, no matter how simple.

As the total expense of a utility

is proportional to three different factors—installed capacity, generated kilowatt-hour and number of customers—it is evident that in an equitable rate these three portions of expense should be charged out in proportion to the demand the user makes on them. Thus, if any customer has a demand of X kw. and uses Y kw.-hr. per month, his monthly bill Z should be:

$$Z = AX + BY + C \qquad (1)$$

where

A = Group I expenses $\div$ total of customers' demand $= S_1 \div dP$ (2)

P = Plant capacity in kilowatts.

d = Total of customers' demands $\div P$.

S_1 = Group I Expenses and

B = Group II expenses $\div$ total kilowatt-hours generated $= S_2 \div G$. (3)

G = Kilowatt-hours generated by utility.

S_2 = Group II Expenses and

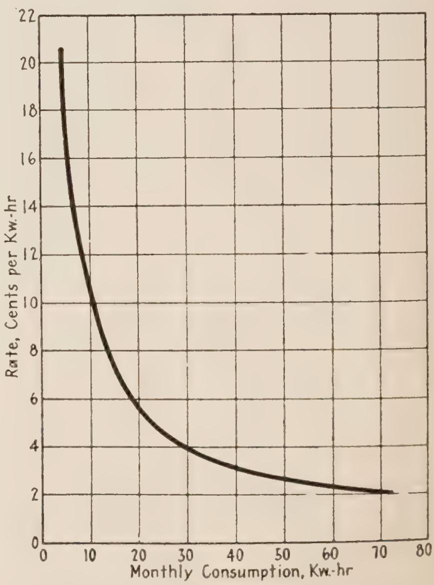
C = Group III Expenses $\div$ number of customers $= S_3 \div U$.

U = Number of customers. (4)

The general bill structure represented by equation (1) is a plane surface inclined to the X, Y and Z axes by angles depending on the relative values of S_1, S_2, S_3. A, B and C are the rate elements and will vary with the different companies and for different classes of service with the same company.

Inasmuch as different classes of services take energy at different voltages and thus demand more or less equipment in the way of distribution systems and transformers, the costs in Group I and II will be divided in general into several subgroups forming the elements of several rates. Thus to form a rate for large consumers taking power at primary voltage, S_1 and S_2 would include no distribution costs. Customers taking energy at distribution voltage would have a rate in which elements A and B were computed from costs including the distribution system but not including the distributing transformers or low-voltage lines, whereas, secondary voltage customers would have rates made up of factors A and B which included all expenses and fixed charges of the utility. The rate for each customer would be of the form, given in equation (1), but the constants A and B would be different for each different class of service.

In this manner, the actual rates



Application of three part rate to residential customers.

would be easy of determination and just for all. Estimated figures of d, G and U would be used based on previous years' experience. Not only would such a uniform rate structure simplify litigation and commission procedure but it would increase the use of electricity for domestic purposes and thus lower costs by improving load factor.

A typical residential rate built up on such a scheme might have constants as follows: $A = 1.00$, $B = 0.006$, $C = 0.50$. As applied to a customer with a 500 watt demand, the minimum bill would be $1.00 a month and the rate would be as shown in the accompanying illustration. With a monthly consumption of 11 kw. hr., the rate would be about 10 cents per kilowatt hour. If the consumption were raised to 36 kw. hours a month, the rate would drop to 3-½ cents.

Several advantages of such a system have been mentioned, and others will become obvious on a more detailed examination. The big underlying value of this scheme is that each class of service is profitable in itself and one group is not made to pay the cost of carrying another.

To thc Late Sir Adam Beck

Great, honorable, generous, noble knight,
Whose task has been to fight the peoples fight
Who, fearless, fought for what you knew was right,
We mourn.
For now the messenger whom all must know
Has called alas, and so too soon you go
And leave great hundreds here below
Forlorn.

Now at the close of your short earthly days
When to your work the world great tribute pays,
We grope as some one in a semi daze,
For aid.
And wonder will there ever be a man
Of courage and integrity, who can
Proceed with the foundation plan
You've laid.

No monument or cenotaph can we select
No matter who may choose or so elect,
But will be shamed by that you did erect;
Your own.
Too well we realize when now we're grieved,
Too prone we've been to doubt what you believed,
Too willing to debate while you achieved
Alone.

And so great benefactor of our land,
Tho we've refused the kindly proffered hand
Because we lacked the sight to understand
We weep.
And evermore upon the book of fame,
Emblazoned at the top shall be your name
While you with conscience free from blame,
Shall sleep.

—*J. Arthur Nichols.*

Wanted More Courage

THE average household in America annually spends about $420 on automobiles, $100 on tobacco, $286 on women's clothes, $85 on men's clothes, $30 on radio, $25 to $30 on electric service and $10.88 on electrical equipment for the home. Probably not more than 15 per cent. of the homes now connected to electric power lines have installed in them today what might be called a complete electrical equipment. This is a smaller percentage than five years ago, because we are taking on new homes faster than we are selling appliances for use in them.

What is the electrical industry going to do about it?

Hundreds of thousands of people wire up each year. Each family is eager for a modern home. They want all the comforts of electric service. But they never get it. It's never sold to them. Electrical manufacturers, central-station companies and dealers combined don't sell enough appliances to even keep up with the growth of the household market. At our present rate these people will all die—and so will we—before complete electrical equipment becomes the standard of the American home.

And the reason why the electrical industry is steadily falling behind the growth of this,its greatest market, is because the electrical man is individually selling the American home too small an order.

John and Mary and their children represent the great American household market. How do they buy other things?

The automobile salesman comes to John and Mary and sells them a thousand-dollar or a fifteen-hundred-dollar car—complete. They want the car. That is the price. They buy—not first the engine, then the wheels, then the body, then the top—but a complete car.

The bathroom salesman also comes to John and Mary and sells them a white-tiled porcelain-equipped bathroom for $1,000 or $1,500, including the necessary plumbing. He does not sell this year a tub, next year a toilet, then a basin, then the floor and then the walls. If he had done so, then the tiled and porcelain bathroom would not now be the standard of the modern home. John and Mary want the bathroom not alone for comfort, but because it is a mark of social standing. They must be modern—so they pay the price and buy.

Why is it that these bathroom and these motor-car salesmen can obtain from the same home that electrical salesmen call on orders for complete equipment that costs $1,000 or $1,500, when the electrical salesman calls and comes away with an order totaling $50, or perhaps $150, for a single appliance—which is but a fraction of a complete equipment?

The automobile industry had the courage to go to the American home and sell expensive motor cars in spite of the low cost of a horse and buggy. The bathroom people had the cour-

age to sell a thousand-dollar equipment despite the cheapness of the china basin and the tin bathtub. The electrical industry has not yet had the courage to go to John and Mary with the same big vision and full purpose and do a complete selling job.

How is the electrical industry to accomplish this? We cannot tell our selling men that they must work longer and walk faster, and sell more. Piecemeal purchasing will never make complete electrical equipment the standard of the American home. There is only one way:

We electrical men must approach John and Mary with a new sales philosophy and a new program designed to bring a fresh thought to them by offering a sensible solution of the Social and economic difficulty that beset every household in the land. Here is the plan:

1. Let us prove the practical and personal advantages of meeting present conditions of cost and labor in the home by doing the housework electrically and modernizing the processes of housekeeping as men have modernized the methods of the office and the factory. Let us sell not just single appliances, but complete equipment.
2. Let us show each household how the mortgage money can be made to pay for the heavy equipment — clothes washer, ironer, dishwasher, kitchen motor, refrigerator and, where the rate permits, a range and water heater—if these are screwed fast and permanently installed when the house is built or bought.
3. Let us also figure for the customer how to make the regular household budget pay for the auxiliary equipment—the vacuum cleaner, sewing machine, fan, toaster, percolator, waffle iron, heat pad and the rest—by setting up an easy-payment contract and a regular schedule of appliances, with a fixed appropriation of so much a month.

For John and Mary would not today possess and enjoy the white-tiled porcelain bathroom and the family car if salesmen had not come and "sold" them with eager enthusiasm and complete conviction, and they could not have bought if the salesmen had not also brought the suggestion of a way to help them finance these large purchases.

John will do his part and so will Mary. They will gladly buy complete electrical equipment. They will give our salesmen, too, a thousand dollar order. They will do it just as soon as the electrical industry will back this bigger vision of the household market with more courageous selling.

And complete electrical equipment will become the American standard—first in the new better-class home—just as it was with the bathroom. Then the older and smaller homes, perhaps already partly equipped, will fall in line.—*Electrical World.*

Association of Municipal Electrical Utilities

Minutes of Meeting of Executive Committee

A meeting of the Executive Committee was held at the office of the Hydro-Electric Power Commission of Ontario on Wednesday, November 11th, 1925, beginning at 2 p.m. The following members were present: Messrs. R. H. Starr, H. G. Hall, J. G. Archibald, O. H. Scott, W. R. Catton, G. J. Mickler, T. W. Brackinreid, J. E. B. Phelps, R. J. Smith, C. A. Maguire and S. R. A. Clement.

Due to the absence of the President, Mr. V. S. McIntyre, Mr. R. H. Starr, Vice-President, acted as Chairman. The Minutes of the Executive Committee of September 9th, 1925, were read and confirmed. This meeting was called for the purpose of considering plans for the Winter Convention of the Association, and was to have been held on November 4th, but was postponed to this date.

Reference was made to the recent bereavement of the President, Mr. McIntyre, on account of the sudden death of his wife.

Moved by Mr. O. H. Scott, seconded by Mr. J. E. B. Phelps,

THAT the Secretary write a letter of condolence to Mr. McIntyre, expressing the sympathy of the members of the Executive Committee on account of his loss.

Moved by Mr. J. E. B. Phelps, seconded by Mr. O. H. Scott,

THAT the bill for flowers sent to Mrs. McIntyre's funeral be paid by the Treasurer on the O.K. of the Secretary, dispensing with the President's signature.

CARRIED.

Plans for the Winter Convention were then considered. Mr. R. H. Starr reported on behalf of the Convention Committee as to preparations that had been made, and drew attention to a request from the King Edward Hotel that the Convention be moved one week ahead.

Moved by Mr. J. E. B. Phelps, seconded by Mr. J. G. Archibald,

THAT the date of the Winter Convention be changed to January 20th and 21st, 1926.

CARRIED.

Mr. W. R. Catton reported on behalf of the Papers Committee suggesting papers to be given at the Winter Convention. The programme decided upon is as in the resolution following:

Moved by Mr. W. R. Catton, seconded by Mr. J. G. Archibald,

THAT the papers to be submitted at the Convention be as follows:

First afternoon—

"Lightning arresters", by F. W. Peek, General Electric Co., Schenectady, N.Y.

Second morning—

1. "Increasing substation capacity", by W. R. Catton.
2. Paper to be supplied by O.M.E.A.

Second afternoon—

1. "Efficient management of Public Utilities".
2. Paper on "Merchandising".

CARRIED.

The Chairman of the Convention and Papers Committees were requested to have details covering plans of the Convention and Papers for advance publication given to the Secretary not later than December 15th, 1925.

Mr. C. A. Maguire then addressed the meeting on the Beck Memorial Endowment, with the object of assisting the members in answering questions concerning which there was doubt, to enable them to go back to their Municipalities and make those details clear and remove any misunderstandings.

The meeting adjourned at 4 p.m.

Nominatons for 1926

The scrutineers for the election of officers for 1926, report the following nominations received, as candidates for the various offices of the Association of Municipal Electrical Utilities for the year 1926.

The names marked with an "asterisk" will appear on the election ballot.

President—Messrs. R. H. Starr*, V. S. McIntyre*, J. E. B. Phelps, R. H. Martindale, E. I. Sifton, O. M. Perry, E. V. Buchanan, John R. Wood,C. C. Folger, W. R. Catton.

Vice-President—Messrs. W. R. Catton, J. G. Archibald, R. H. Starr, O. M. Perry, W. E. Ressor, H. G. Hall*, J. J. Heeg*, T. W. Brackinreid, A. J. Stewart*, E. M. Ashworth, D. B. McColl, J. E. Teckoe, E. V. Buchanan, O. H. Scott, C. A. Walters, W. H. Childs, C. T. Barnes.

Treasurer—Messrs. G. J. Mickler*, R. C. McCollum*, R. T. Jeffrey, D. J. McAuley*, J. G. Archibald.

Secretary—Messrs. S. R. A. Clement* G. J. Mickler.

Directors—Messrs. O. H. Scott*, W. R. Catton*, J. G. Archibald*, O. M. Perry*, J. R. McLinden*, E. I. Sifton*, R. J. Smith, E. V. Buchanan, P. B. Yates, H. G. Hall, J. G. Jackson, E. J. Stapleton, C. A. Walters, J. E. B. Phelps, E. M. Ashworth, Walter Reesor, J. E. Teckoe, C. T. Barnes, J. J. Heeg, T. W. Brackinreid, W. H. Childs, Geo. Crosz, J. W. Bayliss, A. B. Scott, E. H. Caughell, C. E. Kirkby, L. L. Craig, V. S. McIntyre, C. H. Denton, Ben Kerwin, H. O. Weichell, H. F. Shearer, R. H. Starr, C. E. Schwenger, L. G. McNeice, F. C. Adsett.

District Directors

Niagara—Messrs. J. G. Archibald, E. H. Caughell*, W. R. Catton. J. E. B. Phelps*, E. I. Sifton, J. J. Heeg, O. M. Perry A. B. Scott, H. G. Hall, D. B, McColl, V. S. McIntyre, W. L. Falkenham, J. G. Jackson, Capt. J. A. McAuley, V. Martyn.

Georgian Bay—Messrs. J. R. McLinden, E. J. Stapleton*, G. H. Campbell*, S. J. Milliken.

Central—Messrs. W. E. Reesor*, C. T. Barnes*, C. A. Walters*, J. E. Skidmore, O. H. Scott, G. E. Chase.

Northern—Messrs. C. J. Moors*, T. W. Brackinreid.*

Eastern—Mr. R. J. Smith*.

HYDRO NEWS ITEMS

Central Ontario System

The distribution system in Cobourg has been greatly improved by the construction of new line on Division St. The old line was on 45ft. poles inside the sidewalk. The new line has been moved over to the curb and installed on 30ft. poles so that it now runs underneath the trees. All the poles have been painted green and the line presents a very good appearance.

* * * *

Owing to the rebuilding of the Goodyear Company's premises in Bowmanville, a reconstruction of the line existing to serve them will be necessary. Advantage will be taken of this to considerably increase the line capacity.

* * * *

The village of Pickering is only about 25 miles from Toronto, but up to the present has never had electric service. Last year, however, the village trustees made a determined effort and secured sufficient rural contracts to warrant a line being built from Whitby. This will be a single phase 4,000 volt line and 4,000 v. transformers will be used. The poles are now all erected and service may be expected by the New Year.

* * * *

The Council of the township of Haldimand have approved the estimates for installation of eight street lights in the village of Grafton.

* * * *

A section of the Township of Whitby East is practically part of the City of Oshawa. Steps are being taken to make this a voted area.

* * * *

Niagara System

No. 9 unit at the Queenston-Chippawa generating station will be put into operation during the first week in December.

* * * *

The new outdoor sub-station, located near Kleinburg, having a capacity of 150 k.w., was recently put into operation and will supply part of the Woodbridge Rural Power District.

* * * *

A contract has recently been let for the construction of section six on the new Welland Canal located between Welland City and Port Robinson. Requests have recently been received from the Contractor for approximately 4500 horsepower to be used in carrying on this work.

* * * *

A new outdoor sub-station to supply the Town of Port Colborne is now practically completed and will be put into operation about Decem-

ber 15th. This station will have a capacity of 1500 k.w.

* * * *

Arrangements have recently been made for the construction of a new outdoor sub-station, having a capacity of 150 k.w., at Sharon, which is about four miles north of Newmarket. This station will be used to supply the Police Village of Mount Albert, and part of the Newmarket Rural Power District.

* * * *

The 110,000 volt line from St. Thomas to Sarnia, and also the 110,000 volt transformer station at Sarnia, will be put into operation early in the month of December.

* * * *

Thunder Bay System

The 5th generating unit of Cameron Falls generating station, Nipigon Development, will be placed in operation on December 1st. The output of this unit is urgently needed to meet the demands of the Thunder Bay System, as the November load recorded at Port Arthur exceeded 26,000 h.p., an increase of over 3,000 h.p. for the corresponding period last year, while the highest twenty minute demand on the generating station at Cameron Falls has already exceeded 45,000 h.p.

* * * *

The Kaministiquia Power Co. has also increased its demand for Nipigon power and has requested the Commission to reserve a maximum of 6,000 kw. which will be used to supply Fort William customers now served by that company.

Additional timber limits have been awarded by the Provincial Government to the Thunder Bay Pulp & Paper Co., and the Provincial Paper Mills, Port Arthur, the Nipigon Corporation, Nipigon Village and the Fort William Paper Co., Fort William. The acquisition of these limits by these companies will be, in all probability, in the near future, the means of considerable growth and expansion in the pulp and paper industry at the head of the Lakes, all of which will result in additional demands for power in the Nipigon Development. The increased demand will probably require additional development on the Nipigon river over and above the 75,000 h.p. installed capacity of the 6 generating units which will be available at Cameron Falls. The five units at Cameron Falls when in operation will give the Commission an installed capacity of 62,500 h.p. It is impossible at the present time to state the exact amount of power which will be required by the various pulp and paper mills, due to the securing of these additional limits, but from advance information it will amount to at least 25,000 h.p. and in all probability, considerably more than this amount.

Mr. A. S. White Ill.

We regret to report that Mr. A. S. White, Senior Right of Way Agent, is at present in the Toronto General Hospital, where he was compelled to undergo a very serious surgical operation. At the time of writing he is reported as improving and on the way to ultimate recovery.

List of Electical Devices, Material and Fittings

Approved by the Hydro-Electric Power Commission of Ontario in October, 1925.

Appliances

The American Floor Surfacing Machine Co., 518 South St. Clair St., Toledo, Ohio.

"American Universal" Portable Floor Surfacer.

* * * *

Bluebird Limited, Brantford, Ont.

"Colonial Maid" Electric Washing Machine.

* * * *

Canadian Toledo Scale Co. Limited, Windsor, Ont.

Electrically-illuminated Scales, Style Nos. 3015, 3045, 3125.

* * * *

A. K. Coulter (Submittor), 70 Lombard St., Toronto.

Ward Mfg. Co., (Mfr.), 937-9 Wellington Ave., Chicago, Ill.

"Westinghouse" Curling Iron, Marcel Waver and Drying Comb, and Soldering Irons.

* * * *

Gilson Manufacturing Co. Limited, Guelph, Ont.

"Snow Bird" Electric Washing Machine.

* * * *

Hack Oil Burner Co., 1142 Davenport Rd., Toronto, Ont.

Electrical equipment for Oil Burning Furnace.

* * * *

Hale Brothers, 84 St. Antoine St., Montreal, Que.

Christmas Tree Lighting Sets.

* * * *

Independent Pneumatic Tool Co., 32 Front St. W., Toronto.

"Thor" Portable Drills and Grinders.

* * * *

Jordan Roberts Sales, Limited, (Submittor), 16 Grey St., Brantford, Ont.

Jones MacNeil & Camp (Mfr.), Warsaw, Indiana.

"Power King" Portable Drills.

* * * *

Kelvinator Corporation, 2051 West Fort Street, Detroit, Mich.

"Kelvinet" Refrigerator.

* * * *

Kennedy & Kennedy, (Submittor), 1442 Yonge St., Toronto.

The France Mfg. Co., (Mfr.), 10321-35 Berea Rd., Cleveland, Ohio.

"France" Battery Charger.

* * * *

Moffats, Limited, Weston, Ont.

Electric Ranges, Domestic Types, Cat. Nos. E22F, E24F, E25F, E27F, E30F, E33F, E35F, E36F, E37F, E38F, E196F, E294F, E396F, E397F.

* * * *

National Electric Heating Co. Limited, 544 Queen St. E., Toronto.

"Duo" Toaster, Cat. No. 170.

Electric Ranges, Cat. Nos. 422R, 423R, 424R, 426R, 446R, 428R, 430R, 432R, 435R, 436R, 445R.

* * * *

Northern Electric Company,

2835 North Western Ave., Chicago, Ill.

"Gold Beauty" Electric Curling Irons.

* * * *

REED & CAMERON, 188 Adelaide St. W., Toronto.

Electric Table Stove "Veribest".

* * * *

REELHEAT MANUFACTURING COMPANY, LIMITED, 196 Queen St., Ottawa, Ont.

Electrical Equipment for Oil Burning Furnace.

* * * *

WARD-LOVE PUMP CORPORATION, Rockford, Ill.

Motor-operated Pumps and Water Systems.

* * * *

*ARTHUR & FOWLER CO., N. 119½ Browne St., Spokane, Wash.

"A. & F." Circulation Type Water Heater.

* * * *

*SWARTZBAUGH MFG. CO. THE, 1501 W. Bancroft St., Toledo, Ohio.

Table Stoves, Types S-1 and S-3.

Electric Fireless Cookers Model ECI, EC Jr. No. 8.

Marking: "Everhot".

* * * *

*SWAN-HAVERSTICK, INC., 143 E. State St., Trenton, N.J.

Radio Lightning Arrester, "S-H"

* * * *

Fittings

CANADIAN GENERAL ELECTRIC COMPANY, LIMITED, 224 Wallace Ave., Toronto.

Separable composition attachment plugs, Cat. Nos. GE2241, GE624B; body only, Cat. No. GE2242; caps only, Cat. Nos. GE2243, GE625' with metal cover GE662.

* * * *

WEISS & BIHELLER INC., (Submittor), 69 Adelaide St. E., Toronto.

RAMIE UNION ENSCHEDE (Mft.), Holland.

Wire Connectors "Medium Simplex".

* * * *

BENJAMIN ELECTRIC MANUFACTURING COMPANY OF CANADA, LIMITED, 11-17 Charlotte St., Toronto.

Flexible Tubing "Benjamin".

* * * *

THE DUNCAN ELECTRICAL CO. LTD., 2 Inspector St., Montreal, Que.

"D.E.Co." or "D" Fuseless Rosettes, Cat. No. 703.

* * * *

DOMINION MACHINE & TOOL CO. LIMITED, 77 Peter St., Toronto, Ont.

Outlet Boxes—sheet steel.

* * * *

*ARROW ELECTRIC CO., THE, Hartford, Conn.

Medium Base Sockets (as listed on Underwriters' Laboratories cards dated June 25, 26, 27 and 28, 1925).

Medium Base Receptacles (as listed on Underwriters' Laboratories cards dated June 25, 26, and September 29, 1925).

Receptacles for Attachment Plugs & Plugs (as listed on Underwriters' Laboratories card dated June 26, 1925.

* * * *

*FEDERAL ELECTRIC CO., 8700 S. State St., Chicago, Ill.

"Federal" Medium Base Sockets Cat. Nos. 302-03, 332.

Medium Base Receptacles (as listed on Underwriters' Laboratories card dated August 14, 1925).

Porcelain Bushings. Types A1-A6 incl.

Marking: "F.E.Co."

* * * *

*Hart & Hegeman Mfg. Co., (Submittor), 342 Capitol Ave., Hartford, Conn.

Paiste Co., H. T., (Mfr.), 3201 Arch St., Philadelphia, Pa.

Medium Base Sockets (as listed on Underwriters' Laboratories card dated October 2, 1925).

* * * *

*Rodale Mfg. Co., 492 Broome St. New York, N.Y.

Insulating Link.

* * * *

Portable Lighting Devices

The Art Metal Works Inc., Aronson Square, Newark, N.J.

Portable Electric Lamps.

* * * *

Cole Manufacturing Co. Ltd., Lindsay, Ont.

Portable Electric Lamps.

* * * *

P. Dupuy, 287 St. Timothee St., Montreal, Que.

Portable Electric Lamps.

* * * *

Pugh Specialty Company, Ltd. 38-42 Clifford St., Toronto.

Portable Electric Lamps.

* * * *

John B. Salterini, 35-37 West 23rd St., New York, N.Y.

Portable Electric Lamps.

* * * *

Switches

A. Graham Boyd & Company, 100 Front St. E., Toronto.

"Boyd" Thermostatic Switch.

*Allen-Bradley Co., Milwaukee, Wis.

Resistance Appliance (as listed on Underwriters' Laboratories card dated August 25, 1925).

* * * *

*Arrow Electric Co., The, Hartford Conn.

"Arrow" Flush Switches (as listed on Underwriters' Laboratories card dated October 17, 1925).

Surface Switches (as listed on Underwriters' Laboratories cards dated June 17, 1924, and September 25, 1925).

* * * *

*Bishop & Babcock Co., The, Cleveland, Ohio.

Automatic Switch—Float type, Model No. 329.

* * * *

*Cutler-Hammer Mfg. Co., The, Milwaukee, Wis.

Surface Snap Switch, single pole, Cat. No. 7270.

* * * *

Miscellaneous

Canadian General Electric Company, Limited, 224 Wallace Ave. Toronto.

Heater Cord Sets. With cord switch, Cat. No. 190; without cord switch, Cat. No. 189.

* * * *

W. H. Banfield & Sons, Limited, 370-386 Pape Ave., Toronto.

Heater Cord Sets, Cat. No. 651.

* * * *

*Arrow Electric Co., Hartford, Conn.

Edison Plug Fuses. Marking: "Arrow".

*Federal Electric Co., 8700 S. State St., Chicago, Ill.

"Federal" Plug Fuses—Renewable type.

"National" Cartridge enclosed Fuses—Renewable type.

* * * *

*These devices are under the Underwriters' Laboratories label or re-examination service.

* * * *

Prosecution of Jobbing House for Distributing Sub-Standard Electric Curling Irons

A Toronto Specialty jobbing house was summoned by the district electrical inspector to appear before the Police Magistrate at Whitby to answer to a charge of disposing of unapproved curling irons to a retail hardware company in Whitby.

The case was tried before Magistrate Wills on Oct. 19th. It was shown that the Specialty Company had sold a number of unmarked curling irons to which were attached lengths of cotton insulated cord. The sale was admitted, the Company pleading guilty, but explained to the court that this sale was due to a mistake on the part of their shipping department as they had in stock other lines of curling irons which were approved by the Commission.

In view of the circumstances, and the fact that this Company had not previously been summoned for breach of the Regulations regarding sale of electrical equipment, the Magistrate agreed to suspend the sentence on the understanding that defendant would pay for the costs of the action.

Retail dealers in Ontario are warned to scrutinize carefully the appliances which are offered to them by travelling salesmen of manufacturers and jobbing houses, and they should specify on the order that such appliances must bear the approval of the Hydro-Electric Power Commission. The salesman should be able to quote the approval number applying to the article which he is selling. Approved appliances are always marked with the manufacturer's name, and where necessary, with the volts and amperes or watts. If in doubt at any time as to whether a device has been approved the nearest Electrical Inspection office can furnish the information.

Re. Municipal Populations

To enable The Bulletin to give as nearly as possible the correct populations of the Hydro Municipalities as shown in the lists on the inside of the cover, it would be of considerable assistance if the Municipal Officials advise of any corrections that should be made.

—Editor.

THE BULLETIN

Published by
HYDRO-ELECTRIC POWER COMMISSION
of Ontario

190 University Avenue
Toronto

Subscription Price $2.00
Per Year

Gordon Oke Philp

ON December 24th, in the death of G. O. Philp at Niagara Falls, the Commission lost one of its most capable young executives, and Canada a young engineer for whom there was apparently in store a most brilliant future. Early in November, Mr. Philp contracted a form of blood infection which was the cause of his death in spite of a brave fight on his part and all that medical skill could do to help him.

G. O. Philp

Gordon Philp was born in Port Hope and received his public and high school education there. Having decided to train himself for engineering he entered the University of Toronto, graduating as a Bachelor of Applied Science in 1914. During the vacations of his course he received practical experience with the Midland Construction Company in Central Ontario. After graduation he entered the engineering department of the Electric Power Company. On the Electric Power Company being taken over by the Ontario Government in 1916, he entered the staff of the Operating Department

CONTENTS

Vol. XII. No. 12

DECEMBER, 1925

of the Hydro-Electric Power Commission. Upon the acquiring of the Ontario Power Company by the Hydro-Electric Power Commission, Gordon Philp was chosen as the man having the most suitable qualifications, both personal and technical, to act as General Superintendent, a position requiring considerable skill and tact. During the last few years added responsibility was placed upon him and at the time of his death he satisfactorily held the position of General Superintendent of all operation and maintenance of the Commission's three properties, viz.:—Queenston-Chippawa Development, Ontario Power Company and the Toronto Power Company, as well as the operation and maintenance of the substations and transmission lines of the Commission in the Niagara Districts, having a total capital investment of over $100,000,000. A statement of his responsibility and the extent of the properties he managed so successfully for a period of eight years is, in itself, a gauge of the man.

There was, however, another side to his character: the uniform modest dignity and deliberate consideration with which he met his staff or the public, from the lowest to the highest position in life, and the sound judgment with which he dealt with problems presented to him.

Those of us who had the opportunity of close association with Gordon Philp feel a real sense of personal loss and appreciate his rare personal worth along with the high order of his ability as an official and an engineer. During his long illness real concern for his recovery was the underlying thought, not only of friends and acquaintances, but of a great host who only knew of him. Great as was his reputation as a technical executive, this was overshadowed by his value as a man.

"He has achieved success—who looked for the best there was in others and gave the best he had. Whose life was an inspiration and whose memory is a benediction."

F. A. Gaby

Developments of the Hydro-Electric Power Commission of Ontario

By Frederick A. Gaby, Chief Engineer, H.E.P.C. of Ont.

(Paper read before the American Society of Civil Engineers at Montreal, October 14, 1925)

Continued from November Number

Screen House

At the lower end of the forebay (Fig. 7) and serving as a dam for the same, is located the screen-house. This structure forms the entrance, and the control, for the penstocks. The entrance to each of the main penstocks is a modified bell-mouth consisting of three openings 12 ft. 8 in. wide and 29 ft. high at the rack supports. These three openings gradually converge into one opening 16 ft. in diameter at the point of connection to the penstocks. In designing these water passages, particular care was given to the securing of smooth stream lines and consistent changes in velocity. The bell-mouth entrances are sealed by a concrete curtain wall extending down to elevation 542.0 which gives a depth of 28 ft. above the floor of the forebay. Immediately behind the curtain wall, steel-lined gate checks are provided to support structural steel gates.

Fig. 7, Screen House and Administration Building looking down Forebay.

These gates provide a means of unwatering in case it is necessary to inspect the lower sections of the racks, or the penstocks. The intake is divided into three waterways in order that the spans for the gates may be of convenient size and also to permit the use of racks of a somewhat new design. The whole of the rack structure is removable and is split horizontally into two sections for convenience in handling. A specially designed rack follower with an automatic latch arrangement is provided to facilitate the removal of the racks.

The screen-house, as constructed, provides for nine main units, a service unit and an ice chute, and is arranged so that a further unit entrance may be added at the north end. The screen-house is near the edge of the escarpment, only a narrow ledge of rock being left between it and the gorge. Owing to the disastrous results which would follow a failure, the screen-house substructure was designed to resist the full head exerted by water in the forebay.

Penstocks

From the screen-house, the water is carried to the turbines in steel

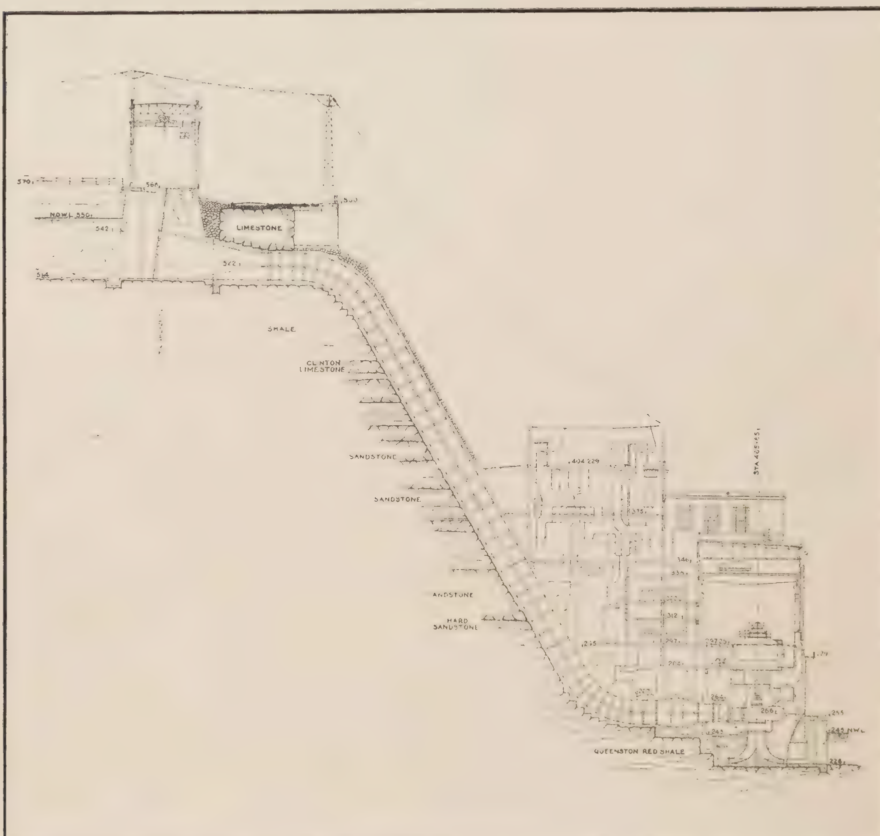


Fig. 8, Section through Screen House, Penstock and Generating Unit.

penstocks. The first five main unit penstocks are 16 ft. in diameter for approximately two-thirds of their length, and are then reduced by a taper section to a diameter of 14 ft. The remaining penstocks are 16 ft. in diameter for their complete length. In the penstocks there are two bends, one located at the top and one at the bottom. These elbows are held in massive concrete anchor blocks, the one at the upper bend forming a foundation for the piers supporting the sidewalk and roadway extending along the edge of the escarpment.

Each penstock ring is made up of two plates with longitudinal joints on the horizontal center line. The joints are all double butt, varying from double riveted at the top to quadruple riveted at the lower end. The circumferential joints are single butt, double riveted with the butt strap on the outside. The longitudinal joints are calked on the inside, but the circumferential joints are made water-tight by electric welding. This type of circumferential joint gives a much better alignment to the inside of the pipe than can be obtained with the usual outside and inside course with lap joints. The plates vary in thickness from one-half inch at the top section to 1-1/4 in. at the lower section. In the erection of the penstock, a new departure was made by the use of electric rivet heaters. Each penstock is covered throughout its length with a concrete envelope having a minimum thickness of 24 in., a protection which will prolong the life of the steel.

Generating and Transformer Station

The generating and transformer station is situated below the escarp-

Fig. 9, View from United States side of river showing Generator and Transformer Station, Penstocks and Screen House.

ment and close to the river's edge, (Fig. 8); the station extends about one-half the distance to the top of the escarpment. The structure required to house nine main units and the service equipment is 650 ft. long. The substructure is of massive concrete construction carried down to rock foundation. The superstructure consists of a structural steel frame-work with reinforced concrete floors and roofs, and concrete, brick and tile walls and partitions.

Turbines and Generators

The turbines each have a capacity of from 55,000 to 65,000 brake horsepower under 305-ft. head at 187.5 rev. per min. The draft tube on No. 1 unit is of the common curved type modified at the elbow, whereas each of the other units is equipped with a Moody spreading tube.

Generators

The present units are each rated at 45,000 kv-a., 80 per cent. power factor, 12,000 volts, three-phase, 25 cycles at 187.5 rev. per min. They are capable of being operated continuously at 49,500 kv-a., with either voltage or current 10 per cent. in excess of the rated values. The units are vertical (Fig. 10) with direct-connected shunt-field commutating pole, 250-volt, 150-kw. exciters. The over-all efficiency of the generators is slightly in excess of 97 per cent. at a power factor of 80 per cent. The thrust bearing is

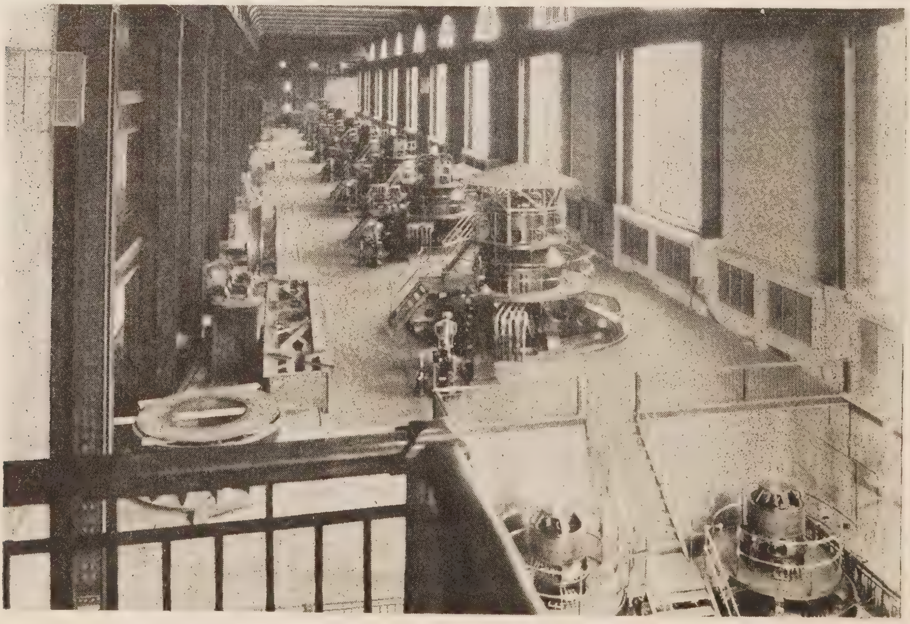


Fig. 10, Generator room Queenston Power House, showing nine generating nnits and service units.

designed to support a load of 1,000,000 lbs. which is slightly in excess of the weight of the rotor plus the hydraulic thrust imposed by the turbine. Upper and lower guide bearings are provided, the latter on account of the length of shaft and in order to keep the generator a self-contained unit.

Gratifying results were obtained in testing the turbine and generator units. An efficiency test of Unit No. 7 at the Queenston Generating Station of the Hydro-Electric Power Commission of Ontario was made on March 21st and 22nd, 1925. The electrical measurements were made by carefully calibrated electrical instruments. Sufficient readings were taken to compute the generator losses and the turbine output was taken as the sum of the generator output plus generator losses.

The measurements of water consumption were made by the Gibson Pressure-Time Process. A detailed description of this method is given in the Trans. A.S.M.E., Vol. 45, 1923.

The outstanding points in the results of the test are as follows:

1. A maximum turbine efficiency of 93.8 per cent at 55 per cent. of full gate opening and 42,210 h.p. turbine output. This is probably the highest efficiency as yet attained.
2. A turbine efficiency of 93 per cent., or greater, for outputs between 36,000 h.p. and 49,000 h.p.
3. A turbine efficiency of 90 per cent. or greater, for outputs between 28,000 h.p. and 59,000 h.p.
4. A maximum turbine output, at full gate and at 294 ft. head, of 64,800 h.p.

Nipigon

At the head of the Great Lakes lies what is known as the Commission's Thunder Bay system. In this territory are the important cities of Port Arthur and Fort William. Tributary to these communities is an extensive territory rich in natural resources, the development of which only awaited the furnishing of adequate supplies of electrical energy. The district possessed valuable undeveloped water powers.

As early as 1901, the city of Port Arthur had embarked in the business of municipal power development and constructed a plant on the Current river. The growing demand for power, however, soon made it necessary to provide for further supply. The results of the activities of the various municipalities in the Niagara district prior to 1906 and the creation of the Hydro-Electric Power Commission inspired the officials of the city of Port Arthur to seek a solution of its power problems along lines similar to those adopted by Niagara municipalities. Subsequently, the Commission purchased power from a power company operating in the district and later, when this source of supply was beginning to prove

inadequate, the municipalities of Fort William and Port Arthur entered into agreements with the Commission for additional power with the result that the Commission made a thorough canvass of possible new sources of power supply. As a result of this investigation, it was decided to commence development on the Nipigon river.

With power available in large quantities from the Nipigon river, the great supplies of pulpwood could be turned into paper at satisfactory costs and, moreover, there became possible the opening up of the mineral and other resources of the Thunder Bay District.

As just intimated, the Nipigon river offered the most favourable possibilities for a development of this proportion. After careful investigation, Cameron Falls was selected as the site of operations, and construction was started in 1918.

The elevation of Lake Nipigon above mean sea level is 850, whereas that of Lake Superior is 602, giving a fall of 248 feet between the two lakes, the Nipigon river forming the connecting link, having a length of about 32 miles. There are four main power sites on the river, the upper two of which may possibly be concentrated at Pine Portage, where a head of slightly over 100 feet could be secured. At Cameron Falls the present station is located, having a head of 78 feet, the headwater level extending some 12 miles up to Pine Portage. About two miles downstream from Cameron Falls, at Camp Alexander, is the remaining power site, where a head of 60 feet is available between the tailwater of the Cameron Falls plant and the level above Lake Helen at elevation 606.0, the remaining four feet to Lake Superior level being difficult of use on account of the uniform gradient of this section of the river.

The area of Lake Nipigon is 1,530 square miles and the drainage basin contiguous thereto is 9,125 square miles, or about six times the area of the lake itself. The discharge from Lake Nipigon is controlled by a ridge at the outlet about 150 feet wide, which marks the beginning of the Nipigon river, and, as would be expected with such a large controlling reservoir, the river has a remarkably uniform regimen, varying from a minimum flow of about 4,000 c.f.s. to a maximum of 18,000 c.f.s. From records taken to date the mean flow is approximately 6,500 c.f.s.

By the erection of a concrete control dam, now almost completed, at the outlet of the lake, the total run-off from the drainage area can be stored in the lake and used as required to meet the variable seasonal load on the plant. The capacity of this huge reservoir is 16,000 c.f.s. for one month per foot of depth, and a variation of four feet is sufficient to give complete regulation of the flow; this variation can be obtained between the natural high and low water levels.

The regulated flow of 6,500 c.f.s. under 78 ft. head at Cameron Falls

with a 60 per cent. load factor, gives a peak capacity of 75,000 h.p., and the plant has been laid out for this installation. Being situated at the lower end of Lake Jessie, which is merely an expansion of the Nipigon river, and flooding back through Lake Maria to Pine Portage a distance of 12 miles, a large still reservoir is created. This area freezes over in the early winter, and by thus providing an ice cover until the spring break-up, prevents the formation of the troublesome frazil and anchor ice. This head pond has an area of over four square miles, and gives sufficient storage to provide for the weekly load factor on the plant, with a variation in the head water level of less than three feet.

At the location chosen, nature has provided a convenient site where the power works may all be concentrated within a small area. In general it may be explained that the power plant is formed by the construction of a dam across the Nipigon river (Fig. 11), and the excavation of short headrace and tailrace channels across the point of land formed by a bend in the river.

The main dam is a concrete spillway structure, provided with eight sluiceways. Regulation is obtained by means of stop logs, and wing walls on either end extend the crest to the required contour level. The stop logs in the sluiceways are raised or lowered by means of an electrically-operated spud-winch, which moves along an operating deck over the top of the spillways. The total length of the dam is approximately 360 feet, and the

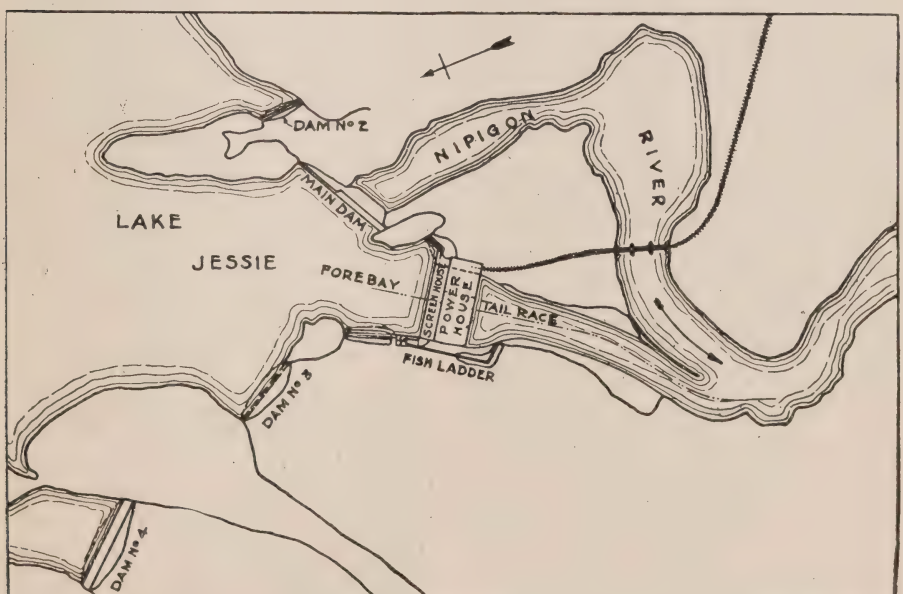


Fig. 11, Plan of the Nipigon Development.

maximum height in the centre is 67 feet. In addition to the main dam, five auxiliary earth-fill dams and one timber crib dam were required.

The forebay occupies an opening in the natural rock walls of the river and is approximately 300 feet long by 263 feet wide. The power house, containing six 12,500 h.p. units is of reinforced concrete, and is of the concentrated type of construction in which the headworks, supply pipes and power house all form part of the same structure. The inlet for each unit is composed of three sections 35 feet high to the underside of the curtain wall by 10 feet wide. Integral steel racks in sections to permit easy handling, are installed in these openings inside the headworks and the maximum velocity through these is approximately two feet per second. Behind the racks are situated the head gates, three gates for each unit, the two outside ones being of the sliding type and the middle one a free roller gate which acts as a bypass in filling or emptying the supply pipes. These gates are all 11 feet wide by 18 feet in height. The sliding gates have bronze bearing strips, while the roller gates are of the stoney type and can be opened against full water pressure. Ahead of the racks and head gates, stop log checks are provided for convenience in unwatering the racks or gates, should such be found necessary. It was considered essential in this climate to house the racks and gates with a building which could be heated in cold weather. Due to this feature, and in combination with the large ice-covered forebay, the low velocity which not only prevents ice being drawn down under the curtain wall, but also gives a negligible loss through the racks, freedom from the operating difficulties usually experienced by power plants in the more northern latitudes has been found even under severe climatic conditions.

The supply pipe for each unit is composed of three rectangular sections each 10 feet by 13 feet. The distance from the head gates to the centre line of units is 86 feet. The supply pipes, which are of concrete, are reinforced for internal water pressure, and for loads from above when empty. The turbine scroll cases are also of reinforced concrete. While the reinforcing required for this head was necessarily heavy, no difficulty was met with either in the design or the construction thereof, and by proper care at construction joints, they are remarkably free from leakage. Ample drainage is provided in the turbine case to handle the leakage from the head gates. The units are spaced at 45 foot centres and the draft tubes are of the elbow type, the upper section having a steel plate liner.

The tailrace is an open cut across to the smooth water in the river below the falls and is about 1,000 feet long by 125 feet wide at the water line. The upper portion near the power house is in rock and the lower portion in earth, a rock-filled timber crib protecting the down-

Fig. 12, Nipigon Power House.

stream end from debris carried down by flood water.

The turbines are of the Francis, single-runner, vertical type, rated at 12,500 h.p. under 72 ft. head, and operate at a speed of 120 rev. per min. The guide bearings for units 1 to 4 are of the lignum vitae water lubricated type, and for units 5 and 6 of the oil pressure babbitted type.

The governors are supplied with pressure from a central pumping plant having duplicate centrifugal pumping units of 650 gal. per min. capacity. Water containing a small amount of potassium bichromate is used for the operating fluid, and has proven quite satisfactory.

Due to the location of the development considerable work of a preliminary nature was found necessary before proceeding with the construction of the permanent works. This included the construction of a temporary power plant, about one mile of railway including a bridge across the Nipigon river, as well as various camp buildings. The temporary power plant consists of two turbines obtained from an abandoned plant, which were utilized to drive one 350 kw. generator and three 300 h.p. air compressors.

The Nipigon river is justly famous for its trout fishing, and to help preserve this sport a fish-ladder has been provided around the west end of the power house. This is of timber construction, and is about 400 feet long. The design of the

ladder was approved by the Provincial Game and Fisheries department, and, it is believed, provides a satisfactory passage for the fish in their annual upstream migration.

Central Ontario System

The Commission, in compliance with applications from municipalities in what is known as the Central Ontario System, negotiated the purchase of the Electric Power Company's System operating on the Trent river, including six generating plants with a total capacity of about 27,000 horsepower. To take care of the continued increase in demand for electrical energy in this district the Commission has since constructed additional developments.

The first of these new plants was located at what is called Dam No. 10, or Ranney Falls, on the Trent Canal near Campbellford.

In the construction of the Trent Canal, below Dam No. 10, the Dominion Government installed intake sluices in the canal wall immediately above locks 11 and 12. It is through these sluices that the water is obtained for operating the Ranney Falls plant.

Fig. 13 shows the general plan of the development—the insert shows the relative position of the plant and locks 11 and 12. Fig. 14 shows a section through one unit.

An open forebay, 124 ft. in length, connects the sluices to the power house. The regulated canal level at this point is 477.0 (sea-level datum). From the power house, the tailrace, 30 ft. in width, extends 275 ft. to the Trent river, the level

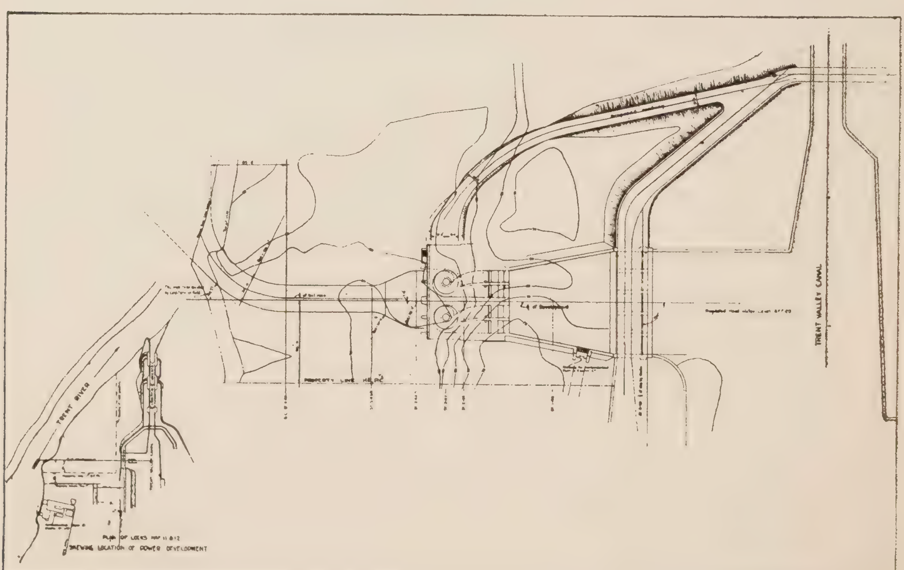


Fig. 13, General Plan of the Ranney Falls Development.

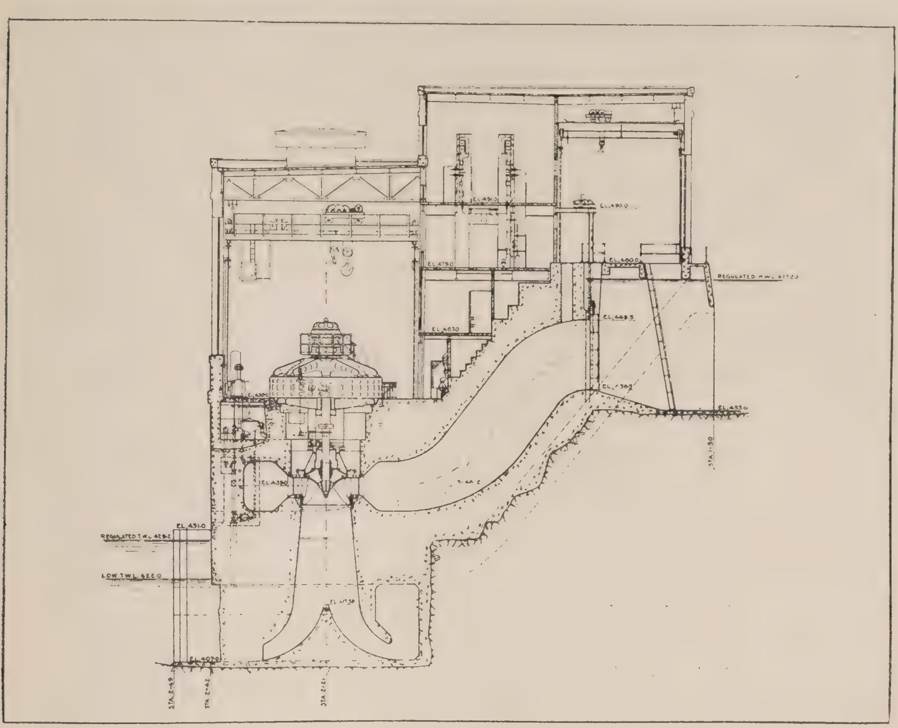


Fig. 14, Section through generating unit, Ranney Falls development.

of which at its junction with the tailrace is 429.0 The forebay is. 116 ft. wide by 12 ft. deep, at the intake. The side walls converge, and the forebay increases in depth, until at the gatehouse the dimensions are 71 ft. wide by 24 ft. deep. This design is conducive to low velocity at the racks.

The gate-house substructure is a block of reinforced concrete, 84 ft. by 30 ft., in plan. There are four entry chambers, two for each unit, 14 ft. in width. The racks are at the head of these, and built of structural steel in two sections. In the centre pier of the gate house a 5 ft. x 4 ft. chute is provided to carry off any ice or other floating material from the forebay.

The double supply pipes connecting the gate-house to the turbine cases are each provided with a gate of the "Stoney" type, one gate for each unit being of the sliding type, and the other of the rolling type. The supply pipes are of reinforced concrete. The double supply pipes converge at the bottom, leading the water to the turbine scroll cases in the proper direction, with minimum eddy loss.

The two turbines are of the vertical single-runner type, each direct-connected to a 4,500 kv-a. generator, and have a rating of 5,000 horse-

power at 120 rev. per min., when operating under 47-foot head. No. 1 turbine is equipped with a Moody spreading draft tube. No. 2 turbine is equipped with a tube built in accordance with the design of the turbine manufacturers.

The two generators are each normally rated at 4,500 kv-a., 3-phase, 60-cycle, 6,600-volt, 120-rev. per min., at 80 per cent. power factor; but are capable of carrying 5,300 kv-a. at 80 per cent. power factor, with cooling air at an ambient temperature of 15 degrees Centigrade.

Dam No. 8 and Dam No. 9 Developments

The second and third developments recently placed in operation by the Commission at Dams Nos. 8 and 9 near the town of Campbellford, contain some interesting features, in that they are automatic and operated by remote-control equipment. This enables their operation to be carried out from a central station at Ranney Falls, which is located about one mile away from Dam No. 9 and three miles from Dam No. 8. It is felt that this remote control feature will effect a very considerable saving in the cost of operation for these two plants, which cost, in the case of smaller developments, is a very appreciable factor in the cost of power.

The Trent river is a canalized stream and forms part of the inland waterway between the Georgian Bay and Lake Ontario by way of the Kawartha lakes. The three main interests making use of the river, navigation, lumbering and power, conflict considerably in their flow requirements, but a regimen for control of the flow has been established which serves as a basis for the installation of generating equipment. The regulating dams were constructed some years ago by the Federal Department of Public Works and the various power developments, of which there are a considerable number, are installed in the neighbourhood of these several dams and take advantage of the fall at the canal locks.

A short distance below Campbellford the river is divided by Meyer's island into two branches, known as the east and west branches. Dam No. 9 extends across the river immediately upstream from the island, being connected thereto by a concrete core wall. Dam No. 8 is situated on the east branch about two miles downstream from Dam No. 9 and a short distance from the lower end of Meyer's island.

The minimum regulated flow down the east branch at the present time available for power is 1,200 c.f.s., some 200 c.f.s. being allowed down the west branch to satisfy riparian owners, but it would be possible to increase this flow by means of storage, to 1,650 c.f.s. The net head at Dam No. 8 is 32 feet and at Dam No. 9, 22 feet, and a flow of 1,650 c.f.s., at the load factor under which it is intended to operate these plants, gives a capacity of 6,600 horsepower at Dam No. 8 and 4,800 horsepower at Dam No. 9.

Dam No. 8 Development

The generating plant at Dam No. 8 (Fig. 15) consists of three 2,200 h.p.

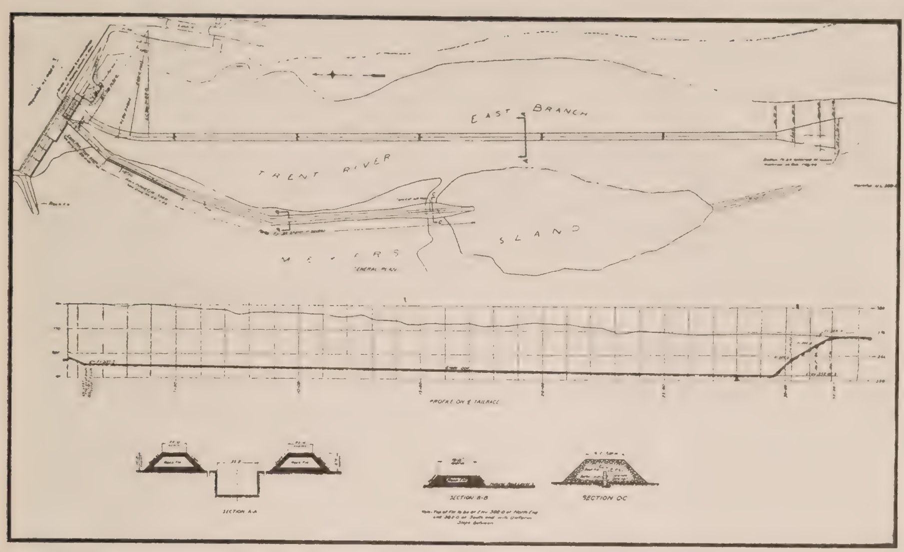


Fig. 15, General Plan, Dam No. 8 Development.

units and the three most easterly sluiceways were used for the installation of the machines. These sluiceways are 20 feet wide, the piers being 6 feet thick, which fixed the spacing of the units 26 feet centre to centre. A considerable saving was effected by using the existing dam structure as a headworks, cutting slots for the racks in the sides of the piers, and extending the piers downstream to form the draft chests. In case one or more of the units are unwatered, the original piers would be subject to side pressure, and, while the piers were considered to be safe as regards bonding, on account of the low ratio of span to thickness, it was necessary to take care of the end reactions. This was accomplished in the case of the lower reaction by pouring a concrete pad in the floor of the four end sluiceways, while the upper reaction was taken care of by drilling through the piers and tying them together with 2-inch tie-bolts and steel plate washers, which were afterwards concreted in. The heavy loads on the turbine floor were carried on a structural steel framework composed of two parallel girders spanning between piers and two I-beams framing into them on either side of the draft tube. This method of construction, it was felt, would give added rigidity and, besides facilitating construction, would be cheaper than the usual flat slab system of reinforcing. The same method was used to support the generator floor, which also carried very heavy loads, as well as being under considerable vibration. This floor had also to be reinforced for upward pressure. The draft tube bell was constructed

of steel plate bolted to an upper cast-iron section and fastened rigidly in place at the lower end to the tailrace piers. A concrete cone 6 ft. 6 in. high, securely anchored into the tailrace floor, was provided for each unit. Stop-log checks for unwatering the draft tubes were provided in the tailrace piers.

The tailrace which is an open cut in the river bed 33 feet wide by about 17 feet deep in the average, extends down to the foot of Meyer's island a distance of over 3,000 feet from the power house. Ordinary methods of rock excavation were used in taking out this cut, which was in solid limestone, and, while the sides were necessarily rough, the bottom was comparatively smooth, due to the limestone strata being approximately horizontal. The roughness factor as determined from tests was about 0.37, which was slightly less than that used in the preliminary computations for tailrace losses.

Surplus and flood waters are diverted through the westerly sluices of the dam across Meyer's island to the west branch of the river, instead of allowing them to flow down the east branch thereby reducing deposit of material in the tailrace cut, as well as avoiding some loss of head. This diversion necessitated the construction of a gravity retaining wall from the west corner of the power house over to the island, a distance of 220 feet, and a rock-filled timber-crib and rock-fill section from the end of this retaining wall along the east side of the island for a distance of about 1,500 feet.

The hydraulic equipment consists of three vertical units, in open-flume setting, each of which is rated at 2,200 horsepower under 32 foot head. These turbines are of the single-runner reaction type, and operate at 150 rev. per min. The governors are of the oil-pressure type, and as the piping for the three units is interconnected, and as one pumping unit is of sufficient capacity to operate two units, it is felt that no trouble under operating conditions will be experienced from this source. The noteworthy feature about this station, as previously mentioned, is the installation of automatic and remote-control equipment to enable the units to be operated from Ranney Falls station. The additional attachments to the governors required include a solenoid which may be energized or de-energized and a synchronizing motor which records the speed of the units, with the necessary automatic features such as valves, dashpots, etc., to enable the operations of starting, synchronizing, putting the machine on load, closing the gates and applying the brakes to be controlled from the remote station.

Dam No. 9 Development

The layout at Dam No. 9 development (Fig. 16), where the generating plant is also in three units, while similar to Dam No. 8 in many ways, has some essential points of difference. Five power sluices, each 20 feet wide, had been built in the side of the canal, just upstream from the canal lock, for the accommodation of the turbines. However, as the

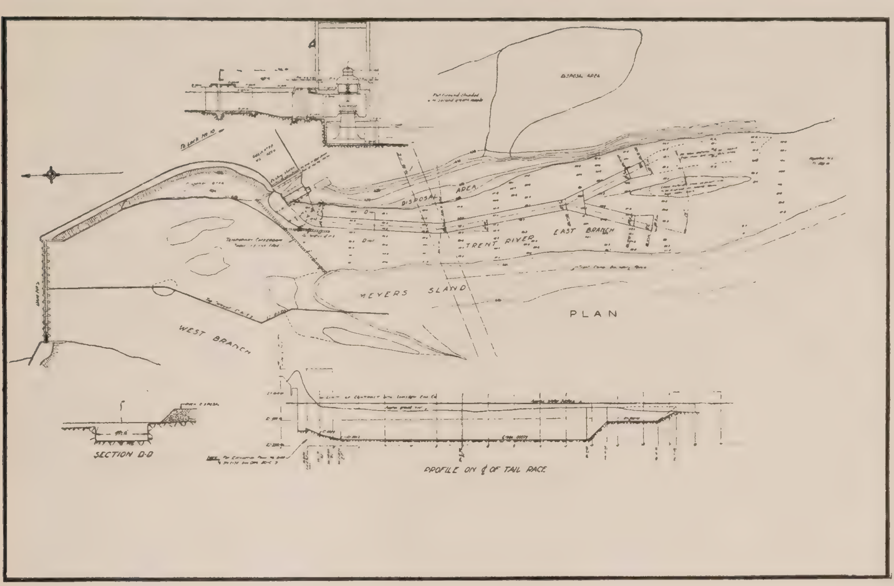


Fig. 16. General Plan Dam No. 9 Development.

piers were only four feet thick and the concrete showed some signs of disintegration, it was considered inadvisable to adopt a power-house layout adjoining these piers as at Dam No. 8. Therefore an inner forebay was provided by constructing concrete wing-walls, and the power-house was located about 25 feet downstream from the existing sluices. This layout necessitated the construction of a headworks section to contain the racks, immediately adjoining the power-house proper.

The power-house layout adopted and the method of carrying the floor loads were somewhat the same as in the sister plant at Dam No. 8, with the exception that the turbine floors were reinforced-concrete arches. This type of construction was made possible by the fact that the existing rock surface was above the floor level. The units were spaced at 30-foot centres, which gave a longer span for the generator-floor slabs, but the loads from the weight of the machines were lighter than at Dam No. 8. The draft tube bells are steel-plate also, but no concrete cone was used here. Stop-log checks were also provided in the tailrace piers for unwatering.

The tailrace was excavated in the bed of the river and extends down to the slack-water which is also the head pond for the Dam No. 8 development. This cut is 1,400 feet long by 40 feet wide and averages about 12 feet in depth, branching out into two channels near the end, one branch on each side of a small island.

The turbines are of the open-flume, single-runner, vertical propeller type, and are rated at 1,600 horsepower under 22-foot head, oper-

ating at 180 rev. per min. The governor and piping layout is almost a duplicate of that at Dam No. 8, the governors themselves having the same automatic and remote-control features.

It is possibly too soon yet to state that these two plants, which are unique in that they are the largest of the remote-controlled type yet constructed in America, have been an unqualified success, as they have been operating only a comparatively short time. Nevertheless, the conclusion to be drawn from operating experience so far is that the development of many power sites hitherto considered commercially impracticable will probably be brought within the range of economic feasibility, due to the saving which can be effected by the installation of remote-control equipment.

We have now reviewed the salient features of the more important of the generating plants serving the Commission's systems. Appended to this Paper is a Table presenting details of a number of these features. The plants that the Commission has under development will, when completed, aggregate 1,000,000 horsepower. The whole undertaking has been carried forward on the basis of municipal co-operation. The municipalities are financially responsible for the undertaking and the Commission, on behalf of the municipalities, and the municipalities in connection with their local utilities have invested $275,000,000 in order to obtain their electrical energy at cost.

H.E.P.C. Distribution of Power in Ontario Extention of Operation

October 9, 1925

System	Area served in square miles	Length of District East and West	Length of District North and South	Number of Municipalities	Population	Estimated System demand Dec. 1925, H.P.
1. St. Lawpence.						
St. Lawrence Division	2,100	85	30	18	28,000	
Ottawa Division	400	30	16	5	134,650	
Rideau Division	1.500	60	36	5	16,350	25,550
2. Central Ontario	4.700	126	67	41	145,000	45,000
3. Niagara	13,500	236	101	254	1,800,000	700,000
4. Georgian Bay.						
Eugenia Division	4,050	76	76	30	46,500	
Severn Division	2,300	50	62	21	44,500	
Wasdells Division	1,300	25	59	14	19,100	
Muskoka Division	1,250	42	30	2	3,900	20,000
5. Nipissing	700	27	30	4	13,500	2,750
6. Thunder Bay	4,000	90	50	2	17,000	45,000
Total	35,800			396	2,269,500	838,300

System's Data

Summary of Capacity of Plants—H.P.

System		Capacity	Ultimate capacity present plus undeveloped
Niagara			
O.P. Co.	183,500		
T.P. Co.	145,000		
Queenston	440,000 (8 units)		
Purchase			
C.N.P. Co.	20,000	788,500	898,500
Central Ontario		47,028	53,128
St. Lawrence			
Purchased		10,000	
Rideau		3,450	6,550
Ottawa			
Purchased		20,000	
Thunder Bay		50,000	75,000
Nipissing		3,600	5,600
Georgian Bay			
Severn Division	5,800		
Eugenia Division	7,400		
Wasdells Division	1,000		
Muskoka Division	5,250	19,450	29,950
		942,028	1,068,728

Water Powers of Ontario

THE Department of Lands and Forests of the Province of Ontario has recently published a list of water powers in the Province as prepared by Mr. L. V. Rorke, Director of Surveys and Chief Engineer. The list of water power sites has been compiled from the most authentic data available, to meet the constantly increasing demand for information regarding the water power resources of Ontario. The compilation of the list and the estimation of the power available at the various sites was carried out with the direct co-operation of the Dominion Water Power and Reclamation Service, of the Federal Department of the Interior. In addition to their data and that of the Department of Lands and Forests, information was also secured from, amongst others, the Ontario Department of Mines, the Hydro-Electric Power Commission of Ontario, the Temiskaming and Northern Ontario Railway Commission and the Geological Survey of Canada. High accuracy in the estimate of water power requires continuous stream flow records over a long period of time and, as such long term records are available for only comparatively few of the rivers of the Province, many of the estimates are subject to revision as more is learned of the run-off characteristics. Nevertheless, the estimates will give a fairly close approximation of the power possibilities of the Province and serve as a starting point for the more detailed study of individual sites.

The Province is divided into two main drainages, from the northerly of which the waters find their way to Hudson Bay and from the southerly into the Great Lakes and St. Lawrence river system. For the purpose of this report the northerly drainage has been sub-divided into three lesser basins, the first being directly tributary to Hudson Bay, the second to James Bay and the third to Lake Winnipeg. The southerly drainage has been sub-divided into six basins, the first four of which are tributary to the Great Lakes—Superior, Huron, Erie and Ontario—while the remaining two basins are the St. Lawrence river proper with its small local tributary drainage, and the Ottawa river drainage.

Summary of Available and Installed Power.—A summary of the estimated available power and the installed power as at January 1st, 1925, in these various drainage basins is given in Table 1, hereunder

The totals of available power shown in Table 1 include only the amount of power in the Niagara river, which is equivalent to the diversion of water permitted by treaty. The total potential power possibilities of the Niagara would raise the provincial totals to some 5,330,000 h.p. at ordinary minimum flow and 6,940,000 h.p. at ordinary six months flow.

TABLE I.—Available and Installed Water Power in Ontario Totalled According to Principal Drainage Basins.

Drainage Basin	Est. Capacity in H.P. at 80% Efficiency		Installed H.P.
	At Ordinary Minimum Flow	At Ordinary Six Month Flow	
Hudson Bay	26,759	53,513	....
James Bay	525,862	950,982	117,085
Lake Winnipeg	199,944	328,696	36,645
Lake Superior	181,787	303,822	90,600
Lake Huron	221,502	413,000	168,993
Lake Erie	3,292	8,923	11,367
Lake Ontario	1,054,935	1,101,060	1,030,705
St. Lawrence River	791,308	956,561	17,671
Ottawa River	423,763	708,986	112,267
Totals	3,429,152	4,825,543	1,585,333

In considering the totals in Table 1, the mistake should not be made of deducting the installed power from the available power to ascertain the remaining undeveloped power. Studies have indicated that throughout Canada generally installed power is about 30 per cent. greater than the corresponding six months power. On this basis, therefore, the water power resources of Ontario would permit of an installation of 6,270,000 horse power, or if the total potential power of the Niagara river be included an installation of 9,000,000 horse power. The water power resources of the Province may thus be said to be from 18 to 25 per cent. developed.

The administration of water power on the Crown lands of Ontario is under the control of the Minister of Lands and Forests, and they are leased in accordance with regulations approved by the Lieutenant-Governor in Council on January 16, 1907, based upon section 58 of the Public Lands Act (Cap. 28 R.S.O., 1914). These regulations specify the information to be supplied by an applicant for a water power privilege, with plans and proof of his financial ability and intention to carry out a satisfactory development. Before the lease is issued the applicant is usually required to deposit a sum of money, varying with the importance of the project, as an earnest of good faith.

If the application is approved, a lease of the power site is issued by the Minister of Lands and Forests upon such terms and conditions and at such rental as may be fixed by the Minister. In practice the rental is usually fixed at one dollar per horse power year for the developed power, together with a small annual rental for the Crown lands overflowed. The maximum term of the lease is twenty years, but the lessee has the right of renewal for two further and successive terms of ten years each upon such conditions

as may be agreed upon or may be fixed by the Minister. The lease specifies the amount of power to be developed in a given time, provides for approval of plans, inspection during construction, maintenance, fixation of rates on surplus power not used by lessee, the protection of fisheries, floating and navigation, and other matters.

At the expiry of the lease the water privilege reverts to the Crown, together with the permanent structures erected by the lessee on the land covered by the lease. The lessee is permitted to remove his machinery, and may also be compensated for the permanent structures to an extent determined by the Lieutenant-Governor in Council and approved by a vote of the Legislative Assembly.

Transmission of Pictures Now on a Commercial Basis

By W. B. Buchanan, Assistant Laboratory Engineer H.E.P.C. of Ontario.

THE broad principles of picture transmission have been recognized for years but their reduction to successful practice required among other things, perfection of methods for the faithful transmission of electric signals over long distances and the development of special apparatus and methods which have become a part of the communication art only within the last few years. Prominent among the newer developments which have facilitated picture transmission are the photo-electric cell, the vacuum tube amplifier, electrical filters, and the use of carrier current. None of the systems heretofore devised have been sufficiently developed to meet the requirements of modern commercial service.—Journal A.I.E.E., November, 1925.

Now, however, picture transmitting and receiving apparatus has been permanently installed at New York, Chicago and San Francisco where public offices have been opened to accept material for such transmission and the fact that for speed and accuracy the system meets the exacting demands of modern commercial practices adds a new interest to this phase of communication. In view of the general interest of the readers of the Bulletin in things pertaining to radio, carrier waves, etc., it is probable that many of its readers would be interested in Reprint B-122-1 of a paper published in the Bell System Technical Journal, April, 1925, Vol. IV, No. 2, on the Transmission of Pictures over Telephone Lines, by H. E. Ives, J. W. Norton, R. D. Parker and A. B. Clark.

Aside from the fact that the article is copyrighted it is difficult to do more than suggest its contents be-

cause it is a very concise treatment supplemented by illustrations which demonstrate more accurately than can be done by words the methods used and the results obtained.

The problem has three essential elements; the first is some means for translating the lights and shades of the picture into some electrical equivalent; second, an electrical transmission channel, and third, a means of retranslating the signals as received into lights and shades, and their relative values and positions as in the original. It has been possible to extend the scheme to a three-color photograph transmitted over a telephone line, as three separate black and white records, each corresponding to one primary color.

The pictures are considered as consisting of parallel straight lines. In one type of reception the lines are uniform density but varied in width to suggest density of the image while the other system adopts lines or bands of uniform width and uses variation in the density of the line to indicate variation in the picture. Each method has advantages and disadvantages.

Only a suggestion of the immense amount of development and research work is given by references to the works of investigators on various divisions of the subject. Carrier Current Telephony and Telegraphy, Printing Telegraph Systems, Electric Wave Filters and other complex equipment all add their share in accomplishing such wonderful results.

Several useful purposes are named in which this system should prove useful. Picture news service, photographs, cartoons, finger prints, hieroglyphics of many kinds, all furnish material for this new telephotographic service.

Another Lightning Accident to a Radio Installation

IN the September issue of the Bulletin, we gave an account of a serious accident which occurred about twenty miles from Toronto where a radio antenna system was struck by lightning and the house destroyed.

Another accident, somewhat similar in nature, but with less serious results, was described in the Cleveland "Plain Dealer". It would appear that both of these accidents were due to the same electrical storm, but the Cleveland installation evidently had been very carelessly made, and a number of makeshift devices had been used.

For the Province of Ontario, the Rules and Regulations of the Hydro-Electric Power Commission cover the installation of radio equipment for both transmission and reception, and take the place of the National Electrical Code of the United States. Radio listeners should be careful in installing their sets to have them in accordance with the Rules and Regulations. (June, 1924.)

The following is the account which appeared in the Cleveland "Plain Dealer"

May 31, 1925.

Set Struck by Lightning—But Was Providence to Blame?

The Answer is "No" and the Moral, "Don't Use Makeshift Devices"

Of course you all remember the destructive storm of about a week ago, with its accompaniment of lightning, hail and wind?

Perhaps its connection with radio may seem remote, but it would not if you had seen what that storm did to a certain receiving set in West Park.

A heavy bolt of lightning struck the aerial where it was attached to the chimney, burned the stranded wire in two, split the stone chimney cap, then shot down the lead-in to the lightning switch, jumped a three-quarter inch air gap between terminals, blew open the receiver cabinet as though a charge of powder had been exploded inside, punctured a cell of the "A" battery, and then apparently passed on into the earth through the instrument ground wire attached to a water pipe in the basement.

Where the lead-in passed through the side of the house a large blackened area showed on the weather-boarding and the wall paper, but fortunately no blaze followed the charge. The lamp cord lead-in that entered the house through a section of circular loom was fused to bits so abruptly that a youngster standing near by bears on hand and arm perhaps a score of bruises or burns where the hot metal and insulation struck him.

Lightning does strange things. In this instance perhaps the strangest of all was the fact that the five-tube receiver was apparently undamaged except for a melted connection to the fixed condenser in the antenna circuit, through which the bolt found its path to ground. Yet the heavy cabinet was splintered and torn apart, and the metal panel warped badly. The lid flew up so violently that it upset the loud speaker resting upon it.

So much for what happened; but the real reason for visiting the scene was to find out why it happened, and the reason for writing about it is not to frighten owners of receiving sets using outside aerials, but rather to encourage them in taking proper precautions against just such an occurrence.

First it should be said that, so far as Static is informed, only two radio installations in Cleveland have been struck and damaged by lightning. In the first instance, some years ago, no protection against such damage had been provided. In this latest instance, just described, a number of weaknesses in the line of defence against lightning may well be cited.

First, no lightning arrester of any sort had been installed, yet such a device is absolutely required by underwriters' rules; lack of it probably would have voided property insurance had damage been done to the house or contents.

Second, the lightning switch was an inadequate affair, made at home from parts of some other electrical device, without sufficient contact surface to carry heavy currents, and with too little air spacing between terminals.

Third, a joint in the lightning ground wire had been so loosely made, apparently without pliers, that it constituted practically an open circuit, thus encouraging the lightning to take the alternative path to earth through the instrument ground.

Fourth, the lead-in bushing was of circular loom rather than of porcelain or other heat and moisture-resisting substance thus increasing the probability of fire following a lightning discharge.

There is no question that many other receiving sets, and the houses in which they are used, are almost if not quite as poorly protected against lightning, chiefly perhaps because the owners have not fully realized the destructive effects of an electrical discharge where it is not wanted.

Yet the means of safeguarding sets and homes from lightning are well known, nor are they expensive or difficult to install.

Frequently these means have been described in The Plain Dealer and all other publications dealing with radio. Yet the regrettable occurrence just noted makes it seem well worth while to tell again what is required by regulations and common sense, to afford protection during the summer season.

Absolutely essential is a lightning arrester of approved design.

Almost equally important is a lightning switch of large proportions and rugged construction, so connected that when thrown to its grounded position, it forms a shunt around the arrester.

Such a switch is not permitted to be used as a substitute for the arrester. Switches may be forgotten, but arresters are automatic.

Desirable, also, if not essential, is a fuse in the lead-in to prevent possible damage should the antenna come in contact with power wires.

As a further safeguard, a switch rated at not less than twenty amperes at 250 volts may be placed between the arrester and the receiving set.

Those unfamiliar with electricity and its manifestations may readily run great risks of which they are not aware, unless they seek expert counsel regarding the installation of their receivers.

Yet those who may feel timid about such installations during the season for electrical storms should remember that there are only two known instances of lightning striking the many thousands of aerials in Cleveland.

The moral is, make certain that the requirements and recommendations of the National Electrical Code as well as local regulations, have been complied with. Then you may rest assured that your antenna is a protection to you and your property rather than a grave hazard.

Lightning Again

IN a recent issue of the Bulletin and in the preceding article accounts have been given of lightning accidents to radio sets, where the aerial had been struck. Lightning has been known to strike the socket type of aerial, however, without seriously damaging the set.

It would appear that the safety of the set depends to some extent upon the design of the attachment plug, chiefly the arrangement of the fixed condensers within the plug. In the case recorded in the following paragraphs from the Cleveland Plain Dealer, the lightning evidently found it easier to jump across the wires than to puncture the condensers and pass through the receiver. An attachment plug designed with short spacing between the incoming conductors and using condensers that have a high puncture voltage rating should effectively protect the set against lightning.

Lightning in Socket Aerial—Set Unhurt

Lightning's freaks are proverbial. And in these latter days, they are especially interesting as applied to radio.

The "Plain Dealer" radio laboratory has just had opportunity to examine and test a socket aerial connection or antenna plug that was damaged by a lightning stroke while the crystal set attached to it escaped unscathed.

This happened in the home of an east side listener within the past week.

During the afternoon a crash was heard. Investigation showed that lightning had struck the electric light wires and run in to the antenna plug, which was badly damaged before the 5-ampere fuse in the basement blew.

But no other harm was done, apparently because the charge jumped from the "live" side to the "grounded" side of the lighting circuit, inside of the plug, instead of taking the alternative course through the set and its water-pipe ground.

As many radio fans doubtless are aware, most socket aerials consist essentially of two prongs to make connection to the light wires, and two binding posts from which wires are extended to the set.

To prevent the flow of current through the set, small fixed condensers are inserted between the prongs and the binding posts, inside the antenna plug.

In the instance just cited the insulation of one of these condensers was perforated and a portion of the thin brass connecting plate fused. This shorted the condenser, so that the plug had to be removed from the socket before a new fuse would stay in the lighting circuit.

The inside of the plug was charred and blackened by the lightning discharge.

In the case of outside antennas, lightning arresters are depended upon to prevent damage. Apparently the lighting circuit fuses will perform a similar function in the case of socket aerials.

Omission

In connection with the article "Lightning Strikes Radio Aerial" in the September *Bulletin*, pages 327 to 330, we neglected to state that the photographs of the house from which the cuts were made were loaned to us by the Deputy Fire Marshal of Ontario.

Association of Municipal Electrical Utilities

Election of Officers for 1926

The election ballots for officers of the Association of Municipal Electrical Utilities for 1926, will contain the following names.

PRESIDENT:
R. H. Starr (Acclamation).

VICE-PRESIDENT:
J. J. Heeg.
A. W. J. Stewart.

SECRETARY:
S. R. A. Clement (Acclamation).

TREASURER:
D. J. McAuley.
G. J. Mickler.

DIRECTORS:
J. G. Archibald.
W. R. Catton.
J. R. McLinden.
O. M. Perry.
O. H. Scott.
E. I. Sifton.

DISTRICT DIRECTORS:

Niagara District:
E. H. Caughell.
J. E. B. Phelps.

Georgian Bay District:
G. H. Campbell.
E. J. Stapleton.

Central District:
C. T. Barnes.
C. A. Walters.

Northern District:
T. W. Brackinreid.
C. J. Moors.

Eastern District:
R. J. Smith (Acclamation)

Coolie Wages

By Richard E. Smith

Advertising Manager, Southern California Edison Co., Los Angeles.

I HAVE some friends whose principal indoor sport seems to be putting out the lights. When Fred goes in the house and leaves the light in the garage, Helen promptly goes out and turns it off. When Helen comes into the dining room, having left the light in the pantry, Fred is nervous until it is extinguished, and so they follow each other around the house, one turning off the lights which the other forgets.

Being a friend of the family, it was not a social error for me to comment on this one time, to which they replied in unison, much as if they had had several rehearsals, "Our electric bill last month was $1.55."

Think of it! Their electric bill was $1.55. No wonder they wear out shoe leather and their rugs to turn out the lights. The trouble with those poor folks is that they have no sense of humor. I use this expression in the English significance where it means a sense of proportion and balance.

This same Fred spends enough for cigars to light all the houses in the block. He tips check girls and waiters for more than he pays the light and power company. A single trip to a second-rate movie show, which he and his wife take as a matter of course, amounts to more than their electric service for the week. Twice a month Helen pays $1.50 to have her hair "done" and then gives the girl a two-bit tip.

I do not know how much Helen pays for cosmetics, but I imagine this amount would at least compete with the electric bill. If American women realized that the adequate and intelligent use of electric service would make the use of cosmetics largely superfluous, the drug stores would take out their fancy showcases filled with gold-plated boxes and substitute in their place a line of washing machines, vacuum cleaners and electric irons.

There is one more illustration that I want to use before getting into the main discussion. Not long ago another friend of mine who is a radio "fan" made a mistake one night and connected 90 volts to the 6-volt wire. As a result he burned out all of the tubes in the set and the next day calmly paid $24 to replace them. Did he raise a great roar? Did he threaten to go to the Railroad Commission? Did he get up on a soap box and make a speech about corporations? You know very well that he did not—he thought it was a great joke.

In spite of all the things we tell ourselves about our intelligence and our ability to reason, the human mind runs in ruts. From the above illustrations may be seen two of the ruts in which our thinking machine travels. One is a "cheap" run. This represents the mind at work

when it considers some of its needs. Do you remember the great roar that went up during war times when the newspapers raised their monthly subscription rates from 75 cents to 90 cents; when postage was raised from two cents to three cents; when Coca Cola was increased from five cents to six cents, and electric rates made a slight advance? We kicked about these four items whose total effect on our annual budget was about $8.40 and then calmly went out and paid $60 for an overcoat which three years earlier would have cost $18.

The second mental rut might be labeled, "Yes, I know, but we've got to have it." This is the one that explains the complacent expenditure of $24.00 for radio tubes.

Unfortunately the electric mind or consciousness of the American people has been steered into the "cheap" rut. Fred and Helen objected to an electric bill of $1.55, not because such a large amount of money was involved but rather because they are used to getting this service for coolie wages. If an American servant had done all of the things represented by this bill of $1.55, how much would it have cost? During that particular month electric service in Helen's house had done the washing four times, the ironing four times, had cleaned the rugs eight times, had made toast twenty-six times and coffee sixty times and had supplied abundant light for the house and garage for thirty nights, all for $1.55. Even the punjabi could not have approached this for real efficiency and economy.

If the American consciousness has acquired the habit of traveling in the "cheap" rut when electricity is discussed, it is largely our own fault, meaning those of us who constitute the electrical industry. We have encouraged our customers to seek methods of reducing their electric bills. When the tungsten lamp was first introduced, an appliance salesman with more ambition than honesty told his customers, "This new electric lamp has a tungsten element and does not take nearly so much electricity as the old style lamp." He thought he was applying psychology, but he was merely appealing to the "cheap" rut in the customer's mind. Since then gas-filled lamps have been sold promiscuously on the single statement that they reduced the light bill. Many a man has paid the oculist fifty dollars as a penalty for accepting such advice and trying to save a nickel on his electric bill. Beautiful homes on which money has been expended lavishly for rugs, furniture, draperies and general decorations are ruined when Dad brings home a handful of 200-watt type C lamps and installs one in each room.

No doubt the Indian gentleman who can induce the punjabi to work overtime without compensation feels that he has done a very shrewd thing. Is not that exactly what we are doing when we try to shave a nickel from the electric bill and deny ourselves a certain amount of comfort and convenience thereby?

One Woman and Her Electric Servant

On the other hand, we occasionally run across a mind that is running

in the other groove. I recall meeting a lady who said, "My electric bill last month was $12 and I hope it will never be less." No doubt I raised my eyebrows, for she hastened to add, "I never do a stroke of work if it is possible to have my electric servant do it. We burn lights all over the house, in cellar, closets, basement. Maybe it does cost a few cents more, but we get things done quickly without bumping our heads and skinning our shins in dark corners. I am not going to work for two or three cents an hour at manual labor. My time is worth more than that to my husband, my children and my friends. I know that the electric water heater costs money, but is it not worth it to have abundant hot water at any hour of the day or night without a second's wait? Electric service for the refrigerator costs $35 or $40 a year, but I would not go back to the ice man for twice that amount.

This last sentiment is especially apropos at the present time, considering the amount of interest being taken in electrical refrigeration. I doubt if there has been a single conference when some new subject like electric cooking or electric refrigeration was being discussed that someone in the crowd did not remark, "Yes, but isn't it pretty expensive?" It is this pessimistic attitude about our own wares that is to blame for most of the trouble. Where an automobile manufacturer meets competition by improving his product and raising the price, your electrical man seeks some way of getting the job by making it cheaper.

Here we have in America, working for coolie wages, an institution which is the greatest factor in our daily lives and also the least expensive. Of all the items in the monthly household budget the electric bill is the least. We pay more for newspapers which we throw away after a glance than we do for the myriad of services rendered through the electric meter. We cannot get the public mind out of this "cheap" rut until we remove the composite mind of the electrical industry from the same channel.

Returning to the subject of electrical refrigeration, how many men are there in the industry who honestly can say that they exclaimed, "Gee, that's cheap!" when told that one of these machines could be sold for $300. You know perfectly well that they did not say anything of the sort. On the contrary, they raised both hands and remarked, "Well, you never can get anyone to pay $300 for that outfit!" How many Steinways, Packards, and Radiolas would have been sold if the public had been approached from such a standpoint?

An Electric Refrigeration Sales Talk

The way to handle this situation is to invite a prospect to sit across the desk from you and then say, "Now, Mrs. Brown, I've got a fairy story to tell you. I have here a magic touchstone which you may own. With this you will never be bothered by the ice man again. You will never be interrupted while entertaining friends. You will never

have the baby awakened by the crash of ice on the screened porch floor. There will be no more dirty tracks on the sidewalk. You will never have sour milk on Sunday night because the ice man forgot to come on Saturday. You will never have to mop up the floor because someone forgot to empty the pan. You will never have to hang out the card telling the whole neighborhood that you are short of ice. If you wish to leave the house you will not have to leave the back door unlocked for the ice man. In fact, with this touchstone one of the problems of housekeeping will be solved permanently. You will have to make an initial investment but after that the cost will be no more than you have been paying for the old-fashioned modern miracle for about half the price of a Ford car."

Will she be insulted? Will she get angry and run away? No indeed! She may not hand over the $300 before leaving your store, but you can count on one sure thing and that is that she will go home and make life miserable for Daddy Brown until the question is settled.

The Wrong View Point

The reason more electric refrigerators are not sold is that the electrical man does not handle the situation as suggested above. No indeed! He says, "Well, I tell you. That outfit is all right, but you know it costs $300. If you wait about six months they will probably bring out another design that you can get for less."

Don't you see how wrong this is? The customer did not come to your store to save money. She comes to spend money. If she wanted to save money, she would have stayed at home and you would never have known about it. The mere fact that she has shown any degree of interest means that she wants what you have if you will only go half way and let her have it.

The whole scheme of electrical merchandising "got off on the wrong foot." In the early days we used slow-burning wire and fastened it on the joists with wooden cleats. When rubber-covered wire and porcelain tubes were introduced we were horrified at the increased price made necessary thereby. Electrical men all over the country fought the introduction of conduit ordinances, for they knew that their business would be ruined. The man who has sold cord pendants for 65 cents cannot understand how anyone may be willing to spend $65 for a chandelier. Many a man who would have spent $150 to get a good job of wiring in his bungalow has had an electrical contractor come along and argue that all these gimcracks are unnecessary and $50 is all he needs to pay to get his house wired.

The man who thinks in the "cheap" rut sooner or later comes to grief. If he is satisfied with razorback hogs, soon he will give way to his intelligent competitor who appreciates the value of thoroughbreds. If he is an orchardist who is complacent with seedling trees, later he must bow to the man with budded stock. If he is a ricksha man fighting against fate and satisfied

with coolie wages, some day he will retire in favor of an automobile.

Great things are expected from the Red Seal campaign. It is a step in the right direction, and if we can get the electrical mind out of the "cheap" rut it will be successful. On the other hand, unless we do something of the sort it will have hard sledding.

The fundamental thought that we must get into our heads is that the customer does not buy three-way switches, convenience outlets, inch-and-a-quarter conduit and other technical things. He is after just the one thing, namely, comfort and convenience as supplied by electricity. He is building a home and he wants it right. He expects things in it which were missing in his father's home. He may not understand the convenience outlet, but if you tell him that he should have it, he will accept your judgment. The house will cost him more than his father paid thirty years ago, but he also expects that. He is making more money than his father did and he is willing to spend it. Why then, in the name of common sense, do we try to give him a job based on the traditions of 1900 when wooden cleats and cord pendants represented the acme of our art? Joshua made the sun stand still, but he was unique and has no modern counterpart. The world will not stop for the modern business man, and he must get into the procession or else stand by and let others pass.

The punjab waves a palm leaf for two cents a day and the ricksha man trots around with his burden while we smile. "The poor fellow doesn't know any better," we say—and then we look over the blueprints and tell the customer, "Well, this is going to be pretty expensive. If you will take out this set of switches and some of these convenience outlets, we can do the job for $65."

Emerson said, "Hitch your wagon to a star," and someone else remarked, "Not failure, but low aim is crime." If we are to get out of the class of pushcart peddlers and enter the field of merchandising service, we first must get a wider perspective of our possibilities and a greater appreciation of the economic value of our service. When Helen and Fred complain that their electric bill is $1.55, we should say, "Come down to the store tomorrow and I will sell you some things which will raise it to $3, and you will thank me for doing it."

—*Journal of Electricity,*

HYDRO NEWS ITEMS

Central Ontario System

The municipality of Whitby is at present served by the Commission without any contract. On January 4th the people of Whitby will vote on a by-law which is equivalent to the usual enabling by-law, by which the municipality of Whitby will be empowered to make the usual cost contract with the Commission for a supply of power. Whitby's municipal load has been steadily increasing and it is likely that a considerable amount of money will have to be spent by the Commission, in the near future, in additional lines and equipment to give proper service to this municipality.

* * *

New rates have been set for the Oshawa Rural District and it is hoped that they will go into effect in the near future. This will mean a considerable reduction to the rural consumers in this district.

* * *

A paper Company is proposing to locate a factory in the Municipality of Trenton and estimates are being prepared on rates for the supplying of 750 h.p. to this Company.

* * *

New contracts have been received in the Pickering Rural District and the line is now nearly completed. It is hoped to give service to these consumers about the end of January.

Georgian Bay System

A 300 kv-a, 3 phase transformer was placed in service in the Greenbank station on Sunday (December 20th), replacing the original 150 kv-a unit. The change was made necessary due to the rapid increase in load in the municipalities of Uxbridge and Port Perry which are fed from this station.

* * *

Work is now in progress on 2.3 miles of single phase, 2300 volt primary line to serve seven (7) farm customers north of the village of Shelburne. It is expected that this line will be completed and service given to these consumers shortly after the first of the year.

* * *

St. Lawence System

The Village of Finch has renewed negotiations for a supply of electrical energy. Revised estimates will be prepared on a supply being obtained from the Chesterville sub-station.

* * * *

The 4,000 volt, 3 phase line from Chesterville substation, to supply the Police Village of Russell and the Hamlet of Morewood, will be completed about January 15th. This line also will supply the Police Villages of Embrun, Metcalfe and Kenmore when negotiations are completed with these municipalities.

List of Electical Devices, Material and Fittings

Approved by the Hydro-Electric Power Commission of Ontario in November, 1925.

Appliances

A. Belanger Limited, Montmagny, Que.
Hotplate attachment, two and three burner.

* * * *

The Brock Snyder Mfg. Co., Grimsby, Ont.
"Besco" Electric Flat Iron.

* * * *

Century Electric Company, 1827 Pine St., St. Louis, Mo.
"Century" Polyphase Motors, Automatic starting type. Type AS.

* * * *

D. Electric Company, 97 St. Joseph Blvd., Hull, Que.
Stationary Hotplates, Cat. Nos. 12, 20D, 30, 30A.
Portable Hotplates, Cat. No. 6.

* * * *

The Fitzgerald Manufacturing Co., Torrington, Conn.
"Star-Rite" Jr. Curling Iron.
Table Grill No. 545.

* * * *

Maxwell's Limited, St. Mary's, Ont.
"Perfection" Electric Ironing Machine.

* * * *

The National Electric Heating Co., Limited, 544 Queen St. E., Toronto.
Portable Electric Automobile Heater "Diamond E".

Packard Electric Company, Limited, St. Catharines, Ont.
Rectifier, argon gas-filled.

* * * *

Pittsburgh Gage & Supply Company, Box 1236, Pittsburgh, Pa.
"Gainaday" Portable Electric Washers and Wringers.

* * * *

The Purdy Company, Limited, 82 Simcoe St. S., Oshawa, Ont.
Electrically-heated Clothes Dryer.

* * * *

Read Machinery Co., Inc., York, Pa.
"Read's" Cake Mixers, Types F, A, B, and D stationary machines; "Mixonette", portable.

* * * *

Renfrew Electric Products Limited, Renfrew, Ont.
Portable Hotplates, Cat. Nos. 15, 15A, 22.
Stationary Hotplates, Cat. Nos. 20, 20A, 22A and 24.

* * * *

Sperlich and Uhlig Company, 38 Piquette Ave., Detroit, Mich.
"Ironrite" Ironing Machine.

* * * *

Standard Radio Manufacturing Corp., 90 Chestnut St., Toronto.
"Roger's Batteryless Radio Receiving Sets."

* * * *

Superior Electrics Limited, Pembroke, Ont.
"Superior"

Portable Hotplates, Cat. Nos. 51 to 54 incl., 73.
Stationary Hotplates, Cat. Nos. 64, 55 to 59 incl., 72, 82, 83, 84 and 85.
Hotel Toasters, Cat. Nos. 123 to 127 incl.
Air Heaters, Model B. Wall mounting, Cat. Nos. 600, 602, 604, 606, 608, 610, 612, 614, 616 and 618; Floor mounting, Cat. Nos. 700, 702, 704, 706, 708, 710, 712, 714, 716 and 718. Stationary type.
Air Heaters, portable type, Cat. No. 67.

* * * *

*McSavaney Co., Springfield, O.
Electrically-illuminated display signs.

* * * *

*Prosperity Company, The, Inc. (Mfr.), Syracuse, N. Y.
The Beaver Laundry Machine Company, Ltd., (Submittor), 393 Sorauren Ave., Toronto.
"Prosperity-Ezypress Garment Press.

* * * *

*St. Thomas Metal Signs, Ltd., Talbot Street, St. Thomas, Ont.
Portable, electrically-heated cooker.
Marking; nameplate with rating.

* * * *

Switches

The Domestic Electric Company, 7209 St. Clair Avenue, Cleveland, Ohio.
Circuit Breaker Switch, Cat. No. 3163.

* * * *

Duncan Electrical Company, Limited, 2 Inspector Street, Montreal, Que.
"Duncan"
Surface Switches, single pole, toggle type, Cat. No. 100A.
Flush Switches, single pole, toggle type, Cat. No. 350.

* * * *

*Absolute Con-tac-tor Corporation, Beloit, Wis.
Temperature Regulating Appliances (as listed on Underwriters' Laboratories card dated October 16, 1925).

* * * *

*General Electric Co., (Mfr.), Wiring Supplies Division, Bridgeport, Conn.
Canadian General Electric Company, Limited, (Submittor), King & Simcoe Sts., Toronto.
Flush Switches (As listed on Underwriters' Laboratories card dated October 16, 1925).

* * * *

*Hart Mfg. Co., The, Hartford, Conn.
Temperature Regulating Appliance, Cat. No. 10408.
Marking: A letter H enclosed in diamond.
Automatic Switches, magnetically-operated type (as listed on Underwriters' Laboratories card dated October 23, 1925).
Marking: "Diamond H."

* * * *

*Honeywell Heating Specialties Co., The, Wabash, Ind.
Temperature Regulating Appliances, Types A, B, C, D, DS, DSS.

* * * *

*Federal Gauge Co., The, 564 W. Adams St., Chicago, Ill.
Mercoid "Type A" Safety Drip Switch.
Marking: "Type A".

*Nesbitt Electric Mfg. Co., Ltd., 60-62 Duchess St., Toronto.
Panelboards.

* * * *

*Ritter Dental Mfg. Co., The, Rochester, N. Y.
Panelboards.
Marking: "Columbia".

* * * *

Fittings

*Banfield & Sons, Ltd., W. H. 370-86 Pape Ave., Toronto.
Receptacles for Attachment Plugs & Plugs, composition, flush, single and duplex outlet types, Cat. No. 140, 142.
Marking: "Banfield" and rating.

* * * *

*Best Electric Corporation, 476 Broadway, New York, N. Y.
Current Taps "Best Duplex Plug", Cat. No. 500.
Fuseless Attachment Plugs (as listed on Underwriters' Laboratories card dated July 24, 1923).
Marking: Rating and "Best" moulded in letters on casing.

* * * *

*Fralich & Co., S. R., 15 S. Clinton St., Chicago, Ill.
Armored Cable Connectors "Kwikon".
Malleable Iron Fixture studs.
Bushings and locknuts for rigid conduit.
Marking: "K" or "Kwikon."
Ground Clamps "Kwikon" Cat. Nos. 101, 102, 103.

* * * *

*McGill Mfg. Co., Valparaiso, Ind.
Medium Base Sockets (as listed on Underwriters' Laboratories card dated September 22, 1925).

* * * *

Portable Lighting Devices

The T. Eaton Co. Limited, 190 Yonge St., Toronto.
Portable Electric Lamps. "Diamond E".

* * * *

J. H. Edmunds Company, Ltd., 221-227 Richmond St. W., Toronto.
Portable Electric Lamps.

* * * *

The Florentine Co. Limited, 252-54 King St. E., Toronto.
Portable Electric Lamps. "F" or "Florentine".

* * * *

The Miller Company, Meriden, Conn.
Portable Electric Lamps. "Miller Lamps".

* * * *

The North American Bent Chair Co. Limited, Owen Sound, Ont.
Portable Electric Lamps.

* * * *

The Robert Simpson Company, Limited, Toronto.
Portable Electric Lamps.

* * * *

I. Splaver, Rear 7 Fenning Ave., Toronto.
Portable Electric Lamps.

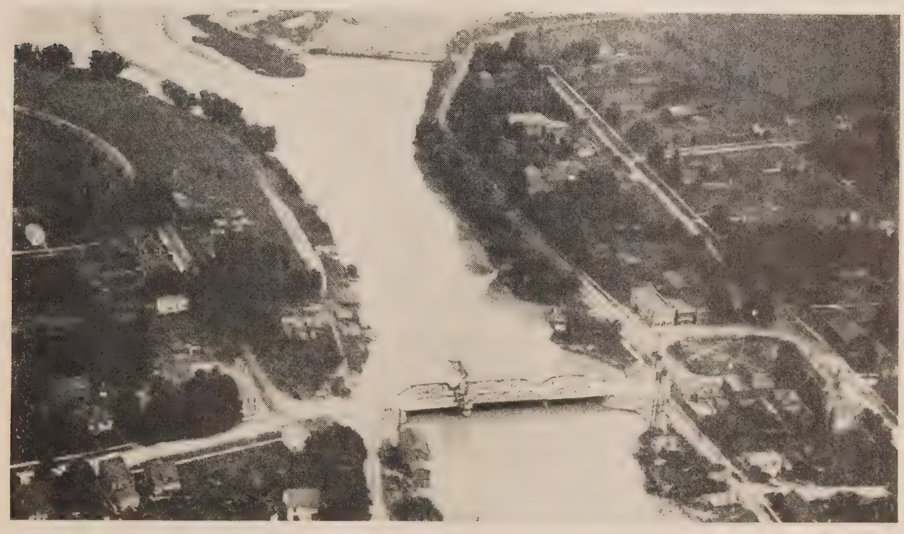
* * * *

Toronto Rattan Co. Limited, 8 Defoe St., Toronto.
Portable Electric Lamps.

* * * *

*These devices are under the Underwriters' Laboratories Label or re-examination service.

Index to Volume XII



Re. Municipal Populations

To enable The Bulletin to give as nearly as possible the correct populations of the Hydro Municipalities as shown in the lists on the inside of the cover, it would be of considerable assistance if the Municipal Officials advise of any corrections that should be made.

—Editor.